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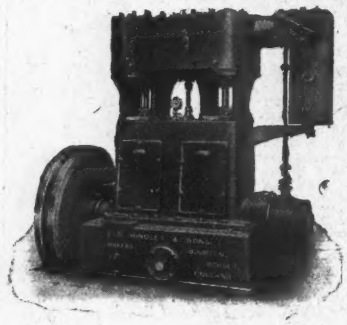

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ELECTRIC POWER SUPPLY.

LAST week we published the report of the Departmental Committee which was appointed by the Board of Trade, in March last, to consider what steps should be taken to ensure an adequate and economical supply of electric power to all classes of consumers, especially to industries which depend upon cheap power. The conclusions unanimously arrived at by the Committee, so far from containing any novel features, may be described, if not as obvious truisms, at any rate as facts with which readers of the ELECTRICAL REVIEW must necessarily be familiar, for the principles laid down by the Committee have been repeatedly insisted upon in articles which have appeared in our pages. It is singular that it should have taken the Government of a civilised country so many years, to say nothing of the greatest war in history, to discover that the policy which it had adopted of chopping up the country into innumerable isolated areas, each provided with its own little generating station under the control of a committee of laymen more interested in local party politics than in the efficient conduct of a highly technical undertaking, was almost the worst that could have been devised.

Government interference from the first has been the bane of electricity supply, both in the Provinces and in the Metropolis, where a similar policy of dissection was aggravated by the institution of competition in each area—a system which appears to touch the limit of fatuity. We sincerely trust that history on this occasion will *not* repeat itself; that for once the intervention of a Government Department may not have a detrimental effect upon the development of the industry. We are encouraged in this hope by the fact that the Committee was unanimous in recording its recognition of the necessities of the future, and the utter inadequacy of the system followed in the past; this fortunate circumstance is due, no doubt, to the powerful influence exerted by the three or four electrical members of this Committee of twelve. Thanks to their guidance, the Committee has been enabled to formulate a true statement of the position, and though the facts were common knowledge amongst electrical men, it should not be forgotten that the general public, and still more the Government, needed enlightenment. The report will, therefore, serve a useful purpose in this respect, at any rate, and the time spent in producing it has not been altogether wasted. We trust that the Committee's proposals to obtain the advice of representative associations throughout the country will be followed up without delay, and that a constructive policy on the lines of common-sense designed not to pander to the political aims of local authorities, nor to fill the pockets of speculators, but to serve the interests of the community as a whole, may speedily be evolved. Whether the demand of the I.M.E.A.—at the instigation of Committeemen—for the more direct representation

of municipal undertakings on the Committee would tend to this result is a matter of opinion; what is required is not the verdict, by a majority, of representatives of sectional interests, but that of a Committee of impartial experts, capable of appreciating the merits of the question, and free to arrive at an unfettered decision based thereon. The municipal undertakings will have ample opportunity of stating their case before the Committee through the medium of the I.M.E.A. The parochial system of supply may be said to be upon its trial, and it is not usual to give counsel for the defence a seat upon the bench of magistrates. However, the inclusion on the Committee of Mr. C. H. Merz may perhaps be regarded as an infraction of the principle in favour of company interests, although, as the leading exponent in this country of electricity supply on the large scale, his right to be there is incontestable, and probably it would be well to offer a seat to an equally prominent municipal electrical engineer, such as Mr. S. L. Pearce, whose experience would abundantly justify his nomination apart from his representative function. At present the Committee appears to us to comprise too large a proportion of non-technical men, and though so far it has arrived at obviously correct conclusions, its constitution would be greatly improved by an increase in the number of electrical engineers amongst its members. The names of Mr. C. P. Sparks and his elected successor in the presidential chair of the I.E.E. at once commend themselves, and to these we might add others—men who are already intimately acquainted with the situation, and are capable of dealing with the real problem of ways and means, without further loss of valuable time.

"Business Must Go On."

IT is somewhat amusing to observe that, on the entry of the United States into the war, the Society for Electrical Development has adopted practically the same "slogan" as we did in this country at the outbreak of war. In spite of the prophetic foresight of Lord Kitchener, few of us at that time imagined that the war would last for years and would, in fact, become the "usual business" of a vast proportion of our industries. The Society has initiated a campaign with the purpose of keeping business moving, holding that "everything depends upon the individuals holding up their links in the chain of mercantile business."

It is, to our mind, unlikely that the industrial upheaval which has taken place in this country will be felt to anything approaching the same degree in the United States, whose internal resources in both raw materials and plant are inexhaustible, and whose works are already largely engaged on the manufacture of munitions, while her needs are far less urgent than were ours in the first years of war; nevertheless, the Americans do not do things by halves, and we are confident that they will, with their customary energy, provide us with agreeable surprises at no distant date.

As regards "Business as usual," however, this will be confined almost entirely to internal trade, for sea transport will be restricted to the utmost, except in the case of munitions of war and food for the Allies. We trust that we shall not be regarded as unfriendly to our latest brothers in arms if we frankly express our relief that for the American campaign to capture South American trade—a species of industrial warfare upon ourselves—there is now substituted a campaign of co-operation and support, and that thus, after the war, we shall be able to enter the competition for the world's trade, if not on equal terms, at any rate without the heavy handicap with which we were threatened.

THE MANUFACTURE OF CONTROLLER DRUMS.

BY R. K. SHIELD.

COMPARED with the number of firms making motors and switchgear, there are very few engaged in the manufacture of controllers; yet it may be hoped that some account of certain processes of manufacture will be of general interest. In outside appearance most of the drum controllers used for cars, cranes, and general industrial applications resemble one another very closely, but an almost infinite variety of electrical connections is set up by modifications in the drum. Consider, for example, the ordinary variations in a standard size of crane controller. They include:—

(*a*) Plain series control.
(*b*) Ditto with shunt brake.
(*c*) Shunt control.
(*d*) Slow motion steps, as required for foundry work.
(*e*) Rheostatic lowering.
(*f*) Limit switches.

In addition to the above, every maker finds that special applications require, perhaps, a dozen other modifications in every size of his standard line. The cross-section of a controller is not affected by these changes, and if the height of the case is originally made to suit the greatest number of

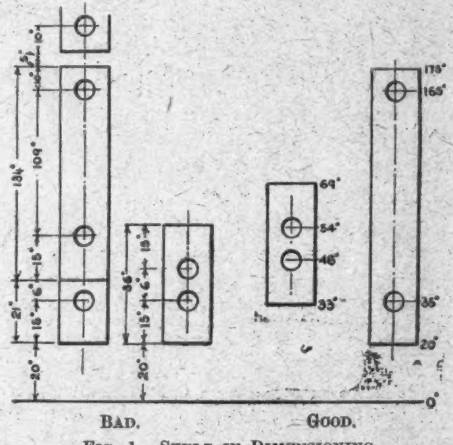


FIG. 1.—STYLE IN DIMENSIONING.

fingers usually required, the only detail affected is the drum, which will vary according to the system of electrical connections to be established. It is thus evident that the standardisation of drums must be of a very flexible nature, and although the problem is not easy, it is, nevertheless, possible to arrange the design in an orderly method, which facilitates, improves, and cheapens manufacture.

In the first place, when getting out a line of controllers, the connection diagrams should be drawn for as many probable varieties as can be foreseen, so that, by mutual accommodation and adaptation, the number of different lengths of contacts and drum castings is reduced to a minimum. If this is not done in a very thorough and painstaking way, the cost of manufacture suffers an initial and permanent handicap.

The making of the drum development drawing from the diagram is a fairly simple matter, but the best method of dimensioning the contact strips is, perhaps, worthy of notice. On the left-hand side of fig. 1 is shown a common, but bad, method, which has persisted from the regular system of dimensioning a drawing in inches. A better method is shown on the right-hand side. This has the advantage that it is more straightforward to mark off the drums in the works when the angular position of the holes is given from zero, that is, the "off" position.

Another point which requires attention in making the drum development drawing, is to arrange that the fixing screw-holes on a series of drums coincide in as many cases as possible. Further, the positions of the holes in the various contact strips should be arranged with a view to the possibility of drilling every piece in the same universal jig,

as described later. Practically every length of contact of a given width, thickness and diameter, whether for D.C. or A.C. controllers, can be arranged for drilling in the same jig.

The usual drum construction is now to clamp cast-iron segments on a mica-insulated square shaft. In designing the castings, the provision of adequate creeping distance along the shaft requires attention, as does also the form of the casting to eliminate cores as much as possible.

The shaft is usually of square, bright mild steel, insulated with micanite wrapped and moulded under heat and pressure. There is a system of moulding the insulation in the shape of a tube on a standard former, after which it is shellacked and pressed in place on the shaft. In the opinion of the writer, there is no advantage in this method, except for those makers who are not equipped for carrying out the whole operation themselves.

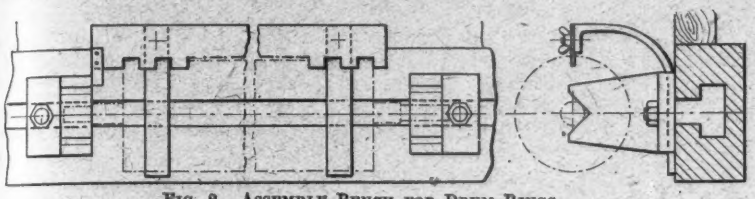


Fig. 2.—Assembly Bench for Drum Rings.

If the drum castings are of good quality, it is unnecessary to machine the square which fits on the shaft. The drilling of the clamping screw-holes need only be mentioned to state that co-operation between the drawing office and tool room will enable the same jig to be used for many castings of different lengths.

In the case of standard controllers, the rings are set in the correct longitudinal position at a special bench fitted with centres sliding on a cast-iron bed and facilities for holding spacing templates, as shown in fig. 2. After the castings are assembled on the shaft, they should be stoved to slightly soften the shellac, which acts as a bond to the mica, after which the clamping screws should be driven home very tight. The next operation is to turn the periphery of the drum, after which it is marked off for the contact screws, or drilled in a jig.

To mark off the contact screw holes, where no drill jig is available, a protractor is mounted on the shaft which is set in vee blocks on a surface plate. The zero method of dimensioning shown on the right of fig. 1 makes the marking of the centre lines of the holes a very simple process, which requires no addition or subtraction of dimensions by the workman.

A good design of drill jig is shown in fig. 3, from which it will be noticed that a hardened bush is provided for every hole to be drilled in the drum. The first cost of such a jig is high compared with some kind of indexing arrangement, but it has the merit of being quick, accurate, and foolproof throughout a long life, during which it returns its first cost over and over again.

It was remarked in connection with the drum development drawing that the contact screw holes should be made to coincide in as many types of drums, of the same diameter, as possible. The object in view was to arrange for the same drill jig to be used on several types, and when this is done the jig contains a greater number of holes than are used on any one drum. On each drawing instructions should be given to leave holes marked, for example, 7, 8, 15, 20, 81, 83 on the jig, undrilled for that particular drum. The driller will fill the surplus holes up with a wood peg before starting to drill.

The contact screw holes will usually be machine-tapped, either in a special vertical spindle machine or with a tapping attachment on an ordinary drilling machine.

The contact strips are invariably made from hard-drawn copper strip cut off to exact length, which is first found by trial and then recorded on the drawing. The bending of short lengths—say, up to about 3 in.—can be done satisfactorily in a hand or power press; but for greater lengths this method is not sufficiently precise, although it will serve, but the bend has then often to be corrected by the assembler. It is better practice—that is to say, more economical in the long run—to use a hand bending roll, as illustrated in fig. 4. The diameter of the bending roll is smaller than the nominal inside diameter of the strip, as, found by trial and by practice, the pressure roll can be screwed up to such a degree that every strip is correct to diameter, in spite of variations in the hardness of the material.

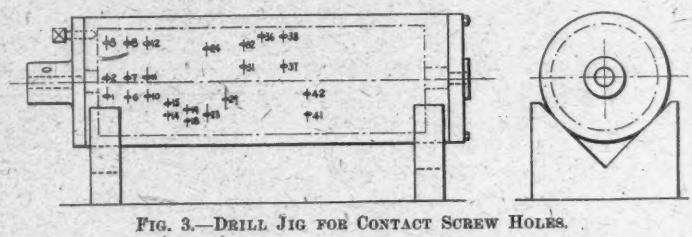


Fig. 3.—Drill Jig for Contact Screw Holes.

A good type of drilling jig for the strips, which are, of course, drilled after bending, is shown on fig. 5, from which it will be seen that the strips are located against a stop at one end by slotted wedges driven across the holes to be drilled, which are generally two in number, and never exceed three.

The advantage of standardising the contact strips can now be appreciated from the design of the jig. The points to be kept in view are that the first hole must always be the same distance from the stop end, and that the other holes shall be limited in number and position, so that they do not clash in the jig. If these conditions are observed, there will be very few strips of a given section and bend which cannot be drilled in one or, at the most, two jigs.

Where renewable tips are provided for the long strips, the ends which butt together must be a good fit, and as the tips must be interchangeable, these ends are best milled to a correct length, measured in degrees, from the nearest screw

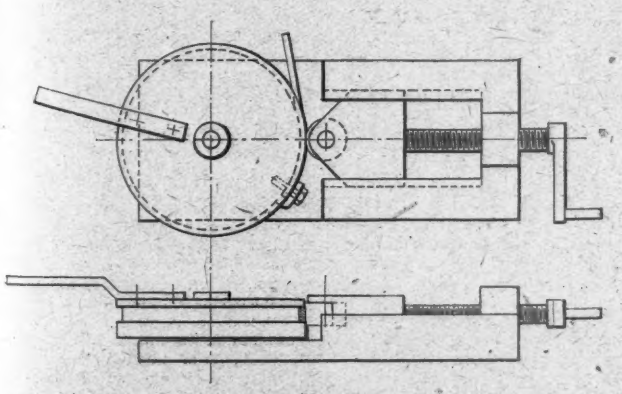


Fig. 4.—Hand Bending Tool for Long Contact Strips.

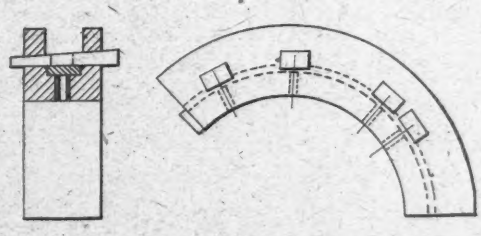


Fig 5.—Drill Jig for Contact Strips.

hole. It is scarcely necessary to sketch a jig for this simple operation, but it may be remarked that a little forethought will enable a jig to be designed which, with very little modification in each case, can be used for all widths, lengths, diameters, and end lengths of contact strips.

After drilling, the contact strips are countersunk, and then screwed in place, for which operation a quick-acting "Archimedian" screw-driver is a time saver.

The last machining operation is turning a light "skimming" from the surface of the contacts, which is done at a high speed with a vee-point tool.

After rounding the contact strips at the front and back ends, the drum is ready for mounting in the controller case, and if the various steps which have been briefly described have been carried out in a proper fashion, there is no need for any subsequent adjustment.

TEAM WORK IN LINE CONSTRUCTION.

By "TRAMP ROYAL."

Let your imagination take you to the car-shed built in the "Mission" style of architecture on the Pacific Slope, and, assuming it has not turned 7 a.m., we shall be in time to see the construction train "pull out" for the day's work. It is the conversion of a steam interurban line to electric, so the track is already in existence. On the train, consisting of a locomotive, a flat-car, and a caboose, we have the construction gang and the apparatus for boring holes.

Having settled ourselves in a vacant corner on the train, we travel to the commencement of the new overhead route, where, in the easy-going way of Californians, the gang dismounts. The hole-borer is adjusted, and each man takes his allotted place. It is only a matter of about 10 minutes, and we are steaming on to the next pole position. All day the work goes on, no hurry, no dawdling, and with just a half-hour's break for lunch, which is taken on a bank under a canopy of cloudless blue sky, what time gophers pop up for a nibble of spare fragments of food. At 5 p.m. we are back in the car shed.

Next morning, we find a change in the train make-up. A flat-car, fitted with a winch and derrick, is sandwiched back and front by a car-load of wooden poles, all ready drilled for bracket arms. At each hole, bored the previous day, the jib picks up a pole, and drops it into the hole, allowing it to lean from the track. It is quick and easy work, as there is no dismounting from the train. A man on the load of poles fixes the grab band around a pole, a man at the winch "sets up," a man on a guy pulls the jib round; the pole is lowered, another man pulls a cord releasing the grab, and the train journeys on to the next hole.

The locomotive and caboose comprise our train for the next day, and the aligning of the poles proceeds. The work is not carried out with the nicety of English pole lines, but it "gets there" all the same, and it matches the surrounding brown country, with its listless eucalyptus and pepper trees. There is no shouting and no wasted effort of a man picking up a spike and finding someone else pushing where he intended assisting. It's the clown at the circus who earns his daily bread by dodging around the carpet and helping nowhere. Outside the circus the clown is not appreciated. Each man has his place in the team, and, under the vigilant eye of the "boss," the pole springs upright, and is held by the three spikesmen while earth is rapidly thrown in and tamped. A man who cannot toe the line is very soon told to go, or, in the vernacular, "to beat it."

The next operation is slower, and takes about two days for the stretch described. A crude tower is fitted on to the flat car, and the bracket arms are put into the poles. These arms consist of a length of pipe, one end of which goes through the pole. The hanger wire, with necessary globe insulators, spans from an eye-bolt in the pole to a bracket at the end of the pipe arm. The fixing of a stay to the arm completes the work on the pole.

The paying-out of the trolley wire is a very interesting operation. The locomotive is dispensed with, and we travel on a flat-car specially fitted with motors and a controller. The further equipment of the car consists of a drum of trolley wire turning on a shaft, and fitted with a hand brake, a tower to carry a man, and supporting a trolley wheel electrically connected to the car controller. The wire is run over the trolley, its end anchored and made alive. Then we all go sailing merrily along. At each bracket arm, the man aloft roughly ties the trolley wire to the span wire for temporary support. The "boss" is at the controller, two men manipulate the brakes, and the remainder of the gang sit by awaiting eventualities, or they take a turn to relieve the other men. It feels good to sit in the sun and be rid of the oil-burning loco's fumes.

The work of the next few days is slower, as it consists of fixing the necessary mechanical ears, guys, "messengers," and "stubs." The "stubs" are pieces of pole about 5 or 6 ft. high, to which are attached the "messengers," or guy wires, at bends or anchoring points.

This work completed, all is ready for "Public Service."

In describing the above I have only taken a day's run, but in, say, a 20 or 30-mile run the whole of one operation would be completed, if possible, before dismantling the erection gear. I should have liked to give figures as to distances, actual time, &c., and also sketches of the gear used; but, unfortunately, my notes are war-bound in California, and it is some 15 years since the described erection took place. I have had to draw upon my memory for the details, but I trust the *raison d'être* of this article has been secured, viz., to show the advantage of team work.

Economy of Gas-Coke as Fuel.—In connection with the appeal issued by the Ministry of Munitions for coke to be used in place of coal, the following result will be of interest:—The Deptford Borough Council during March last year introduced the London Coke Committee's apparatus for burning gas-coke in the steam boilers at the public baths, and now report the following result of a year's working with coke exclusively as fuel. The cost of coal for 12 months from March, 1915, to March, 1916, at the current price of coal, would have been £1,792 12s. 5d. The cost of gas-coke from March, 1916, to March, 1917, has been £1,444 7d. Amount saved, £348 11s. 10d. The saving, which is equivalent to 19·4 per cent., would have been greater but for the large increase in the heating and electric lighting of the buildings owing to the very cold and dark winter, and the increase in the number of warm baths used, estimated at over 9 per cent. The financial saving, despite the adverse circumstances, has exceeded the estimate made by the local gas company who supplied the coke-burning apparatus, which was fitted to the boiler furnaces by the baths staff at a total cost of about one-tenth of the saving effected during the first year.

From the national standpoint, the saving effected by the patriotic action of the Council in using gas-coke in lieu of raw coal is in the by-products recovered by first treating the coal in gas retorts. The by-products recovered from an equivalent quantity of coal so treated include 1,440 gallons of benzol, 9,600 gallons of coal-tar, and 10 tons of sulphate of ammonia (fertiliser).—*Mechanical World.*

A Simple Electric Vehicle.—We have received some particulars of an interesting innovation in electric vehicle construction, which, according to the makers, "will bring down the weight of electrics one-third to one-half of the present figures, and reduce the cost nearly in proportion." Although we are unable to gauge the accuracy of the claim, the makers, the Dey Electric Corporation of New York, have the support of Dr. C. P. Steinmetz in their contentions, and propose to place on the market a light two-seater at a cost of under $1,000. In general outline it resembles a petrol-driven car, but the resemblance ceases here, for the chassis is severely simple, due to the use of a special form of rear axle which incorporates the motor and gearing, and therefore does away with a great part of the usual mechanical driving gear carried on the chassis. The field and armature of the motor revolve in opposite directions, each driving a wheel through gearing, and the motor itself becoming the differential. The use of the Dey axle simplifies and lightens the construction of the chassis and incidentally decreases the weight of battery required or increases the possible mileage. It is said, for instance, that the complete rear axle weighs only 200 lb., and the whole car, including body and battery only 1,400 lb. The Dey car can be supplied to take a battery which will give a maximum of 105 miles run, and is fitted with a control having regenerative and electric braking features.

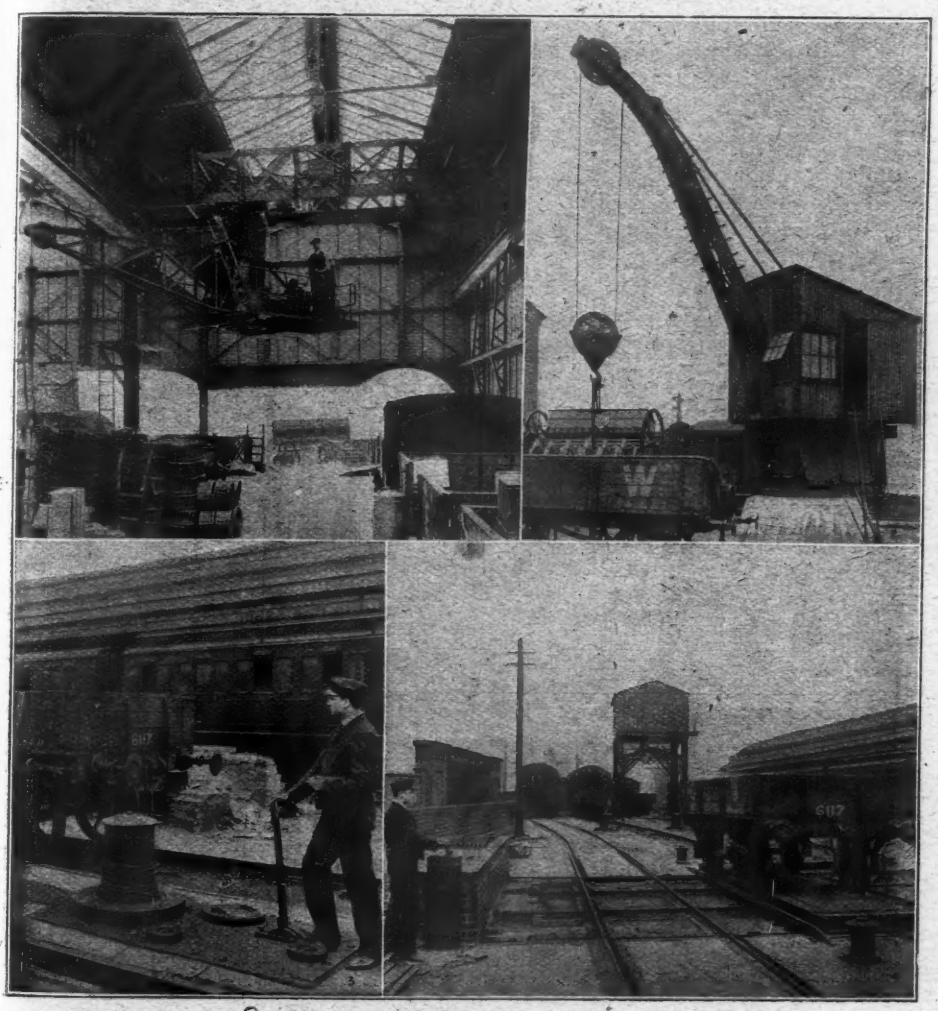
ELECTRICAL EQUIPMENT AT A GREAT WESTERN GOODS STATION.

The following description of the electrical labour-saving equipment at the Moor Street, Birmingham, goods station of the Great Western Railway Co. appeared in a recent issue of the *Great Western Railway Magazine*, to which we are indebted for the following particulars and illustrations.

The design of the equipment was dictated by the peculiar situation of the several goods sheds, the depôt consisting of a high-level goods yard built on a ferro-concrete structure, which also houses underneath a low-level goods station. On the low level are two sheds (A and B) separated by a street, and at different levels, due to the contour of the ground.

Overhead Travelling Crane in Goods Shed.

6-Ton Fixed Jib Crane Outside Goods Shed.



Wagon Being Hauled by Electric Capstan.

25-Ton Bridge Traverser.

High-Level Equipment.

The modern tendency in goods handling of bringing the loading and unloading machinery to the wagons, instead of bringing wagons to fixed cranes, was followed wherever possible, and with this object a variety of modern electrically-operated appliances was installed, the electrical energy for which is obtained from the Corporation supply.

Dealing first with the high-level accommodation, the covered goods shed in the yard comprises under one roof two long sidings, a platform beside one of these sidings and a cart road between the platform and the other siding. The platform and the siding beside it are served for a length of 400 ft. by an overhead travelling crane made by Messrs. Royce, Ltd. The travelling bridge, with a span of 28 ft. 4½ in., moves at an average speed of 250 ft. per min., and carries a traversing carriage with an underhung revolving jib below it, the jib having a radius of 16 ft. The carriage with its jib traverses the shed at a speed of 70 ft. per min., while the jib revolves at a speed of 2 R.P.M., and the hoisting gear raises and lowers a load of one ton at an average speed of 33 ft. per min. This crane can take the load to or from any wagon in the siding from or to any cart in the cart road. Two covered openings in the shed platform are provided, through which goods in special crates can be transferred to the low-level sheds A or B. The electrical equipment was made by the British Westinghouse Co.

Outside the high-level shed is fixed a jib crane capable of raising and lowering a load of 6 tons. The gear can raise and lower its full load at a speed of 20 ft. per min., and slue it at a speed of 2 R.P.M., the jib radius being 15 ft. An automatic electric brake is fitted to the hoisting gear, while provision is made for lowering either by a separate hand-lever brake, or by the use of the motor itself as an electrical brake. The crane, made by Messrs. Stothert and Pitt, is fitted with E.C.C. motors and Allen-West controllers and resistances.

For marshalling the goods wagons, which are raised to, or lowered from, the low-level shed B by a 20-ton lift, the north-east end of the yard is provided with a 25-ton bridge traverser. It is designed to transfer wagons between three parallel lines of rails, the wagon being hauled on to or off from the traverser by an electric capstan. The traverser was made by Messrs. Ransomes & Rapier. Thirteen Clyde capstans and a large number of reels are disposed in the yard to haul wagons, either singly or in trains, to and from 20 and 30-ton wagon lifts, the 6-ton crane, the long siding beside the covered platform, and two turntables at the Moor Street end of the yard. The rope used on a Clyde capstan is never handled by the capstan man except to unwind it from the barrel and haul it to the wagon, which can be done by the hook. This allows steel ropes to be used instead of hemp ropes, which must be used where the rope slips on the barrel, and the capstan man hauls in the slack. The consequent saving in the annual cost of ropes, and in the labour of handling hemp ropes when wet, is remarkable. All these capstans have been made by Messrs. Stothert and Pitt, and the switchgear by Messrs. Morris & Lister, squirrel-cage E.C.C. motors being used.

In the low-level sheds A and B there are 14 similar capstans, four in shed A, to serve the 30-ton lift and traverser and the sidings, and 10 slower-speed capstans in shed B, where the number of sidings is greater. All the necessary reels for guiding the capstan ropes are provided. The electric equipment for the capstans in shed B was provided by Messrs. Crompton & Co.

Shed A contains only two long sidings, for which power appliances are needed. Between the sidings, which run for a distance of 285 ft., are two platforms, one beside each siding, and a broad cart road between the platforms. A cross platform connects the two long platforms, and a "walking" jib crane has been provided, which runs on a one-rail, U-shaped track extending down each platform, and round the cross platform. The crane hoists and lowers its full load of 30 cwt. at a speed of 40 ft. per min., and slues the jib at a speed of 2½ R.P.M.; it has a travelling speed of 250 ft. per min. on the straight, and the jib radius of 18 ft. allows of anything within reach on either platform being transferred to a cart backed against the platform, or *vice versâ*. The crane and top guide, with its three conductor wires, were made and erected by Messrs. Babcock & Wilcox, the motors by Messrs. Harding Churton, and the controllers by Messrs. Allen West.

A 30-ton lift is provided in each shed to transfer wagons between the high-level yard and the shed. The cage can take a wagon 25 ft. over buffers and weighing 30 tons. Such a wagon has been raised and lowered at an average speed of 128 ft. per min. The lifts were made by Messrs. S. H. Heywood and Co., three-phase motors being provided by the Lancashire Dynamo Co., and semi-automatic switchgear by Electric Control, Ltd.

The switchgear is worked by means of a master controller in the cage. Its handle is interlocked with disappearing rail stops on the cage rails. The controller handle cannot be moved until the rail stops have been raised, after the wagon is in position, to prevent its movement either way in the cage. Other safety devices consist of automatic gear to hold the cage should any of the ropes break or stretch unduly; limit switches are also provided to prevent over-travel of the cage either at the top or bottom, which act first on the control gear, and, should this fail, a second switch shuts off the main supply.

In shed A wagons are transferred from the lift to the sidings, or from the sidings to the lift, by a 30-ton wagon traverser. The sidings on either side of the cart road are 100 ft. apart, and only these two sidings are served. The traverser is driven by an induction motor of the one-speed Sandycroft cascade type, arranged to creep while exerting full-load torque; this feature has proved most useful in aligning the traverser rails with the siding or lift cage rails.

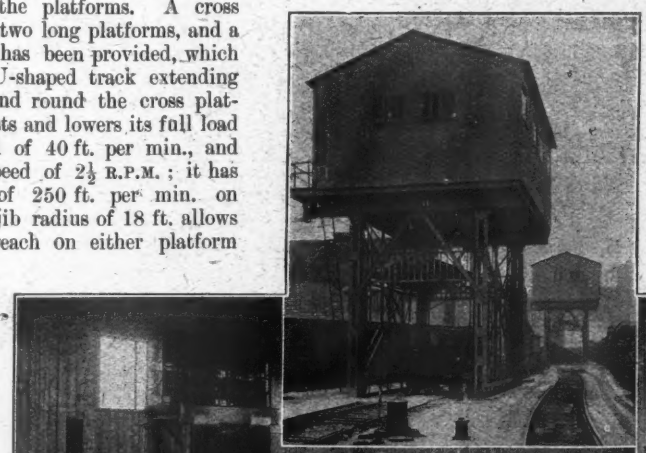
The traverser, made by Messrs. S. H. Heywood & Co., can travel the whole width of the shed with a 30-ton load at an average speed of 285 ft. per min. A capstan with head fixed to the gearing, and using a slipping rope, is provided for hauling wagons on to and off from the lift cage, and is worked by a Sandycroft squirrel-cage motor, with special high-resistance motor windings to give great starting torque for moderate current expenditure. It can give a pull of 750 lb. at 300 R.P.M. and a maximum pull of 2,000 lb.

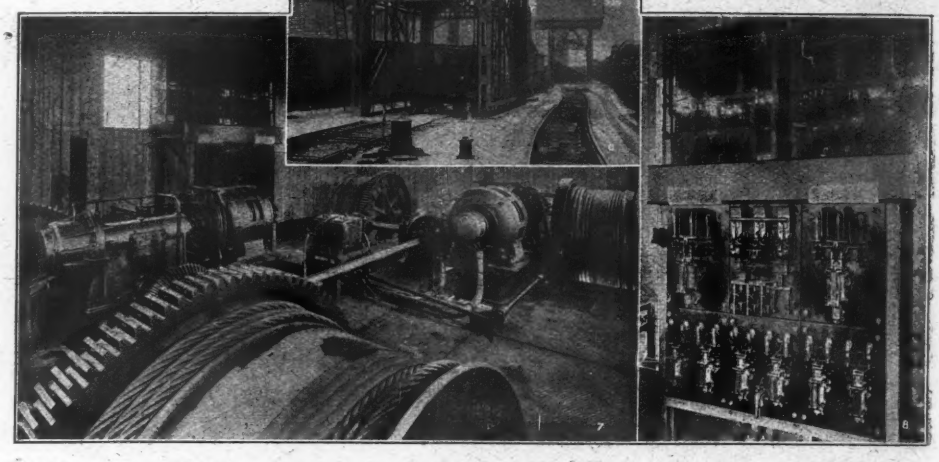
Shed B is served by a similar lift, and the average speed of raising and lowering a 30-ton load is 137 ft. per min.

Shed B is further provided with a 20-ton lift at the corner opposite to the 30-ton one. This was built by Sir William Arrol & Co., with B.T.H. electrical equipment. The height of the lift is 33 ft. 4 in., and the average speed when raising and lowering 20 tons is 145 ft. per min.

Shed B is provided with eight parallel lines of sidings, some of which are only a few feet apart. A 30-ton wagon traverser runs the whole width of the shed for 256 ft. The

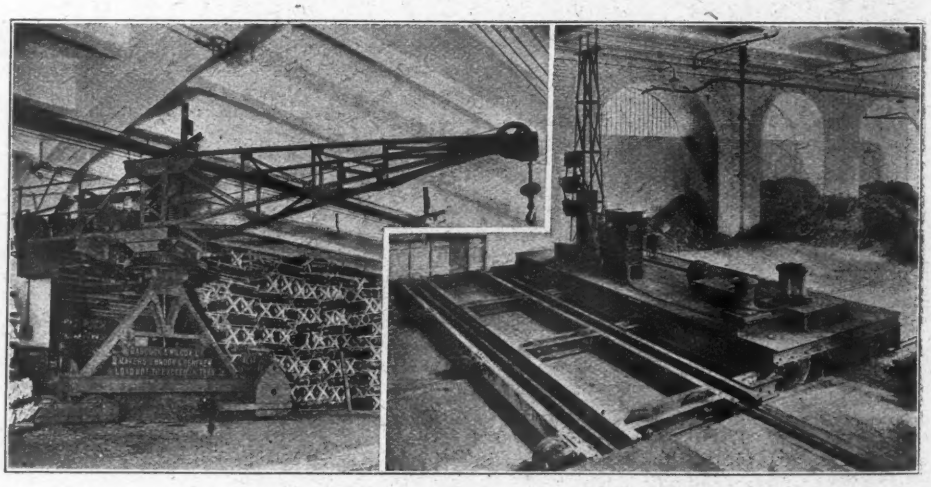
30-Ton Lift Between the High-Level Yard and Low-Level Shed B.





Hoisting and Lowering Gear in Motor House on 30-Ton Lift seen above.

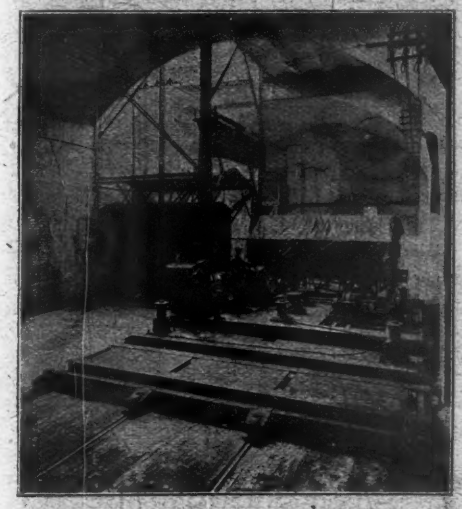
Switch Gear in Motor House.



"Walking" Jib Crane in Shed A.

30-Ton Wagon Traverser in Shed A.

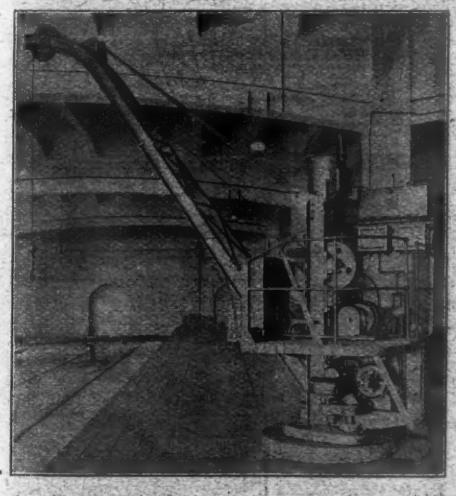
perishable market traffic dealt with in the early morning in this shed requires the most rapid handling possible. This accounts for the high speed of the large lifts, and it was essential that the traverser should not only have a correspondingly high speed but be able to stop very accurately at any of the sidings. This is accomplished by the use of Hele-Shaw oil-pressure transmission gear. By turning a



30-Ton Wagon Traverser in Shed B.

hand-wheel the traverser can be stopped or started in either direction, and the rapid acceleration and high maximum speed obtained (the average speed with a 20-ton load for the journey of 220 ft. being 350 ft. per min.) are combined with the slowest possible creeping speeds and rapid reversing for securing rail alignment.

There being two lifts to serve at opposite sides of the shed, two traversing carriages, each to take a wagon, are necessary. Each of these carriages has been made detachable from the central locomotive, automatic couplings being provided to quicken the process of attaching and detaching.

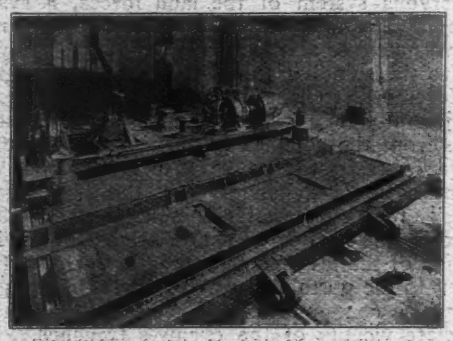


One of the 1-Ton Fixed Jib Cranes in Shed B.

The locomotive part of the traverser is able to haul both traversing carriages, one empty and the other loaded, at an average speed of over 300 ft. per min. for the whole journey. The traverser was made by Messrs. Stothert & Pitt, a Crompton motor and B.T.H. controllers being used. The Hele-Shaw transmission gear was made by Messrs. Compayne, Ltd.

The sidings, lifts, and traversers are worked by 10 Clyde capstans of the same type as described for the high-level yard.

The central loading platform in Shed B is provided with two 1-ton fixed jib cranes, either of which can deliver goods from wagons in the siding beside the platform to the cart roads on the other side of the platform, or *vice-versâ*. These cranes, made by Messrs. Stothert & Pitt, lift loads of 1 ton at an average speed of 30 ft. per min., and slue at a speed of two R.P.M. They are equipped with E.C.C. motors and Allen West controllers. The load can be lowered by a



External Appearance of Transmission Gear on 30-Ton Traverser in Shed B.

hand brake or by using the motor as a brake, and the sluing motion is stopped by a pedal brake.

The whole of the electrical machinery at Moor Street was made to the drawings and specifications of Mr. Roger T. Smith, the electrical engineer to the Great Western Railway.

ELECTRICAL COMMUNICATION IN THE FIELD.

While we hear but little of the uses of electricity in connection with the war, it must not be supposed that they are either few or unimportant. On the contrary, without the aid of electricity it would be impossible for either side to conduct operations on a scale even remotely approaching the vast dimen-

French. (*Official photo.*

Fig. 1.—A French Artillery Observation Post.

sions of the conflict now in progress, for by no other means would it be feasible for the directing authorities to maintain continuous communication with their naval and military forces in every part of the war area, and to gain information instantaneously, and to a great extent secretly, from their scouts and observers both on the surface of the earth and even in the upper air above the enemy's territory. The latter in particular is an achievement which a century ago would have been regarded as a miraculous performance, and a little earlier still

would inevitably have doomed the inventor to a fiery end. But these essential functions of the electric current are fulfilled so quietly, unobtrusively, and efficiently, and have become so commonplace, that no one takes much notice of them; moreover, the men who are responsible for the maintenance of such communications are so modest that they neither seek nor desire publicity.

The telephone and telegraph wires and waves are the nervous system of the land forces, a system whose ramifications extend from the headquarters of Government to all the military commands, beyond them to the sub-divisions of the units, and even to the foremost trenches and observation posts; the apparatus employed comprises corresponding classes, from the complex permanent telephone exchange in town to the more primitive, but still elaborate, local exchanges "at the back of the Front," the comparatively simple switchboards housed in dug-outs in or near the trenches, and, at the ends of the uttermost threads or feelers of the system, to the portable telephone and telegraph sets with which communication is maintained from the immediate vicinity of the enemy's trenches. We

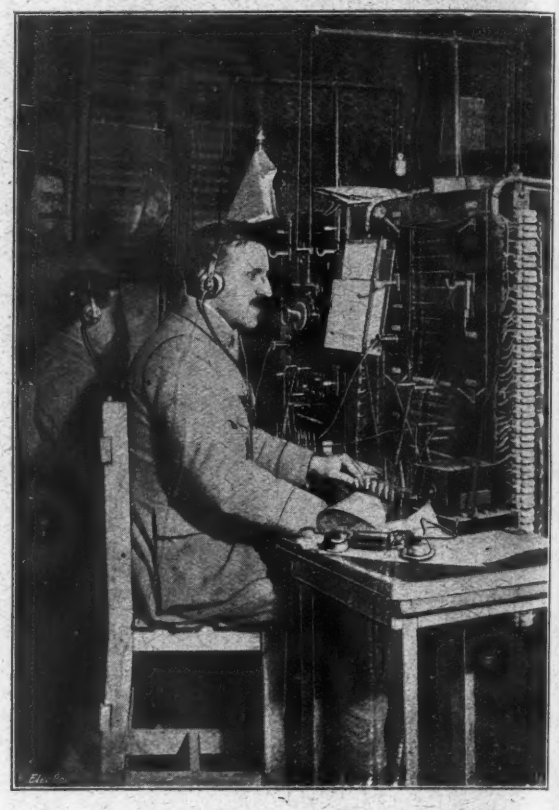
French] [*Official photo.*

FIG. 2.—A TELEPHONE STATION IN THE TRENCHES.

illustrate herewith some examples of the signalling stations used by our French Allies on the Somme, showing successive stages on the upward march from the utmost simplicity to a comparatively high degree of complexity.

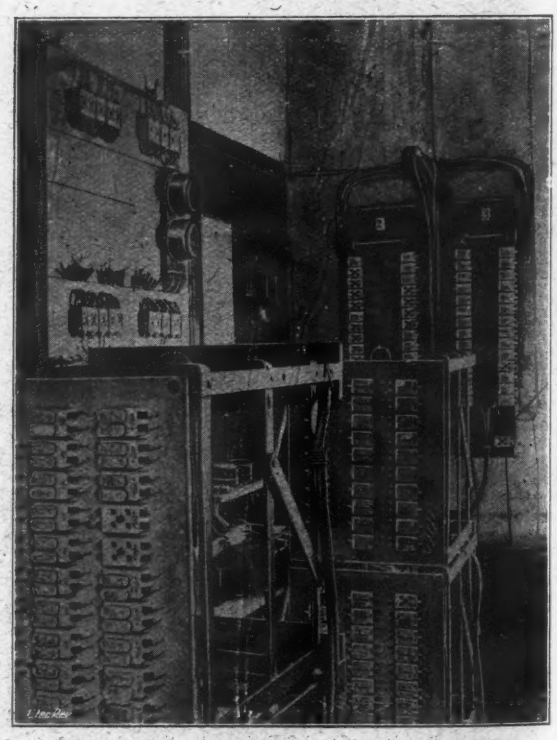
Fig. 1 shows an artillery observer "spotting" in an advanced position, with his telephone signaller close at hand. Fig. 2 represents a telephone station in the trenches, in charge of a single operator. Fig. 3 is a view in the telephone office in the French lines on the Somme; here, it will be seen, a much higher level of elaboration is required, and the apparatus begins to assume the appearance of a branch exchange. Fig. 4 shows a still closer approximation to the equipment of a permanent exchange serving a large number of lines, the station, in fact, attaining to the dignity of a "central" office, and being fitted with frames to carry the cables and apparatus.

In the case of wireless telegraphy, the system, of course, is wholly different; there are no switchboards or distributing apparatus, the place of which is taken by the ether of space. The stations are necessarily more cumbrous than the light portable telephone apparatus, but yet are readily movable



French] [*Official photo.*

FIG. 3.—TELEPHONE OFFICE IN THE FRENCH LINES.



French] [*Official photo.*

FIG. 4.—PART OF THE INTERIOR OF A CENTRAL ARMY TELEPHONE OFFICE.

from place to place. Fig. 5 shows one of the simplest outfits in operation at an outpost, the antenna being simply a horizontal wire stretched be-

tween two trestles, and the earth or "counterpoise" a sheet of metallic gauze unrolled upon the ground. A more pretentious apparatus, requiring two motor vehicles for transport, is illustrated in fig. 6, which shows the staff erecting a light telescopic antenna pole, extending to a height far beyond the limits of the view. The installation can be erected ready for work within a few minutes of its arrival on the scene.

French] [*Official photo.*

FIG. 5.—AN OUTPOST OPERATING A PORTABLE WIRELESS STATION.

We are indebted for these views to Giles's Photo Agency, and for the loan of the block for fig. 5 to the *Wireless World*.

LEGAL.

COUPLING FOR ELECTRIC MACHINERY.

BEFORE the Patents Court concluded its work for the Whitsun recess, Messrs. Croft Bros., of the Thornbury Works, Bradford, applied for licence to use the German patent 11,898 of 1908, in the name of Franz Tacke, for an elastic coupling for joining up dynamos with electrical apparatus, &c.

MR. ARMSTRONG, of Messrs. W. P. Thompson and Co., Liverpool, explained that Messrs. Croft Bros. made many kinds of couplings, and they had lately had special inquiries for this elastic type.

MR. JUSTICE, who opposed the application, said the patent was assigned to one Habermann in 1909, and a licence, sole and exclusive, was granted to the Power Plant Co., Ltd., of West Drayton, Middlesex, who had been manufacturing the coupling under it and supplying the market. They were able to meet all the demands, and to supply Messrs. Crofts into the bargain. The agreement by which they manufactured was not, he admitted, on the register. It was a document prepared and executed in Germany. He was prepared to show it to the Controller, together with the books of the company, disclosing the firms for whom they manufactured.

The CONTROLLER said this was a difficulty which would have to be dealt with. It was a misfortune that they did not get all these documents affecting the title of a patent on the register. He and his colleague, Sir Cornelius Dalton, had felt a great amount of hesitancy, because there might be British manufacturers in this country. There was nothing to force a man to place his name on the register, and therefore there was nothing to show who was the owner of the patent. When new legislation came along, they would endeavour to have the register placed on a proper basis. He sympathised with Messrs. Crofts. The document effecting the transfer of the patent, or showing the interest of somebody else in the matter, was something of which they might possibly know nothing at all till the application came on.

Addressing Mr. Justice, the CONTROLLER added: If this were a court of law, I should make you pay the costs of the day, supposing you convinced me that I ought not to deal with this patent.

MR. JUSTICE: I think cross-examination would show that the applicant was not altogether in the dark. We have been dealing with the entire British and Colonial demand, and supplying ever since the title was granted. Last year we supplied £1,100 worth. The Power Plant Co. is a purely British concern. Not only has it paid a 5 per cent. royalty, but it has paid the income-tax on the royalty. The Power Plant Co. has built up the goodwill, and the applicants now want to collar our business.

The CONTROLLER, after examining the documents, said he was afraid this was one of the rare cases where the agreement was fatal to the application. There had been cases where they felt that it was in the public interest to extend the range of manufacture, but here was a firm working under exclusive licence covered by document, which had gone to great expense to build up the English and Colonial trade, and were coping with the demand. The Court were not disposed to interfere with this arrangement, definitely come to before the war. The agreement had been loyally acted on by the grantees to the best of their ability. It was unfortunate that the agreement was not on the register, but the Court having seen the Power Plant Co.'s books, would not interfere with the course of their business now.

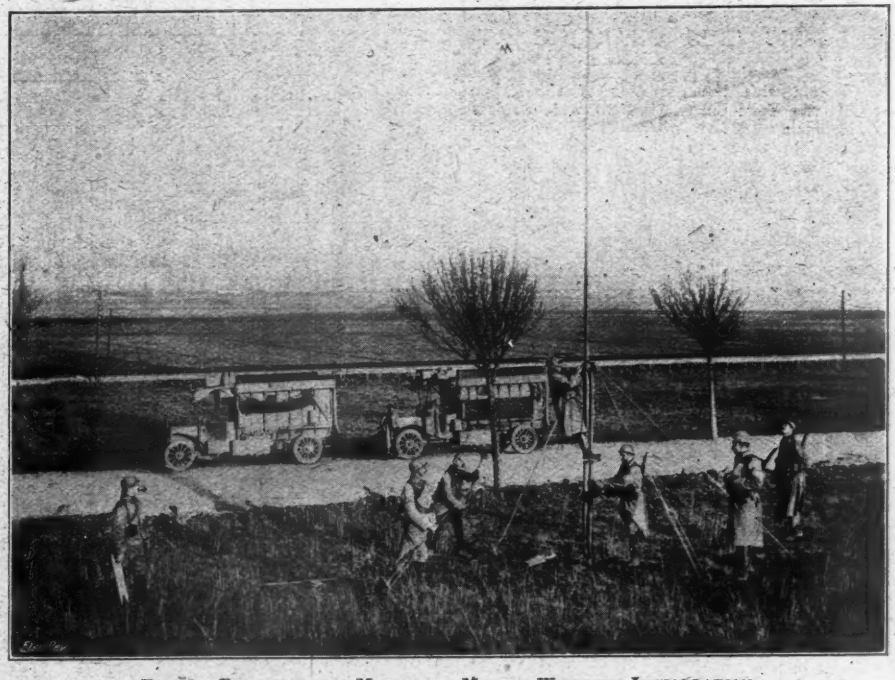


FIG. 6.—ERECTING THE MAST OF A MOBILE WIRELESS INSTALLATION.

The Right to Disconnect.

At Brentford Police Court, recently, the Twickenham and Teddington Electric Lighting Co., of Broad Sanctuary, Westminster, were sued for unlawfully making default in the supply of energy to Stephen T. Whaley, of Spencer Road, Twickenham.

Mr. Terry prosecuted, and urged that there was a *bona fide* dispute between the parties as to the amount of current consumed for the December quarter, yet the defendants cut off the supply. Under the Act of 1909, Sec. 18, they had no power to do this, and in refusing to continue the supply they had brought themselves within the penalty clause.

Complainant stated that there was an arrangement with the company to supply current at 1½d. per unit. For the September quarter, 1915, the consumption was 90 units, and for the next quarter 110, but in the meanwhile a radiator had been installed. For the summer quarter of 1916, 20 units were paid for, and the next quarter 25, and then for the Christmas quarter the meter registered 408 units. He contended that he could not have used so much, as not more than three rooms were in use, and the radiator was only on for about half an hour each evening. The defendants, in reply to correspondence, put in a check meter without his consent, and told him his meter did not register enough. He declined to settle the account, and the company cut off the current.

Mr. Farrer, the manager of the company, stated that they gave the complainant every consideration. It became necessary in 1916 to change the meter, and then came the complaint from Mr. Whaley that it had greatly over-registered the current used. Witness sent a man to inquire, and found there was a radiator which would use about 2 units per hour. They told complainant they were satisfied with the meter, but he could have it tested at a small fee of 5s., which would be returned if it was incorrect. He declined, and witness had a check meter fixed, which showed that the older one registered 5 per cent. slow, and recorded less current than was used. As complainant refused to pay the charges the current was cut off, and the company relied on the fact that the register of the meter was conclusive unless proved to be inaccurate. The winter was severe, coal was scarce, and people used their radiators more than in other years, which accounted for the increased amount of current consumed. Complainant could have had the test made. The right to disconnect was under the Act of 1882, Clause 21.

Mr. Terry said the later Act overrode that.

Mr. Farrer: Even then there is no *bona fide* dispute: either party can have a test made. We did not want one, and the complainant refused. We were quite satisfied with the meter.

The Court held that the complainant should have exercised his power to have a test made, as he was the dissatisfied person. There could be no *bona fide* dispute unless both were dissatisfied. The summons was dismissed, with costs.

ELECTRIC 'BUS CHARGING AT YORK.

In connection with the operation of the Edison accumulator 'buses by the York Corporation, to which reference has been made in our pages, the British Thomson-Houston Co. supplied some interesting charging sets, consisting of motor-boosters with foolproof control gear.

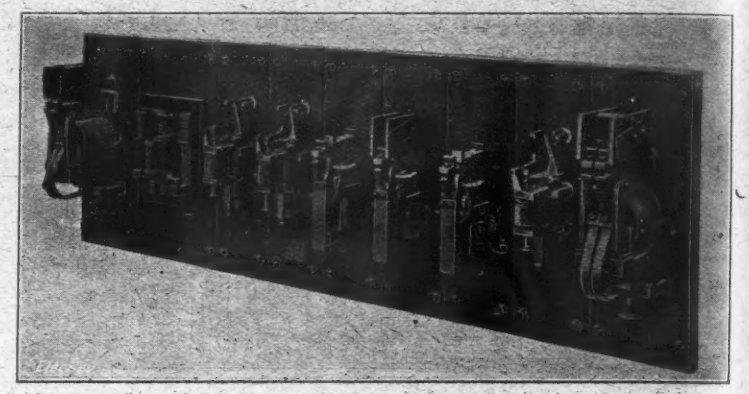
This charging switchgear, which is designed for operation by unskilled persons, consists of an automatic starter and battery switch, having no-volt and overload features, the whole of the switchgear being installed in shelters placed at the outlying terminus, to which these 'buses run, so that the cells can be charged when necessary at the end of the journey.

'Bus Charging Station, York.

The operation of this gear, which is controlled from outside the building, and the function performed by the switchgear, are as follows:—

On closing a small snap switch, the motor booster set is started up, but before this can be done, a field reostat controlling the generator field must be brought back into the weak field position; this rheostat is interlocked with the other gear, so that it is impossible to start up the set except under these conditions. The closing of the switch puts into operation the control gear of the motor, which consists of special B.T.H. series-contactor switches, which close in the correct sequence, bringing the motor up to full speed. The generator voltage may then be raised by means of the field rheostat, until a point is reached at which the voltage is just above the voltage of the battery being charged, when the automatic battery switch closes the circuit to the accumulators, the charging current being further regulated by raising the generator voltage by means of the field rheostat.

The automatic battery switch is arranged to open in the case of reverse currents, due to the booster set shutting down from any cause whatever.



Charging Switchgear for Electric 'Buses.

Overload relays are also included, giving efficient protection against earth on either pole of the generator circuit, and against overload on the motor circuit itself. When any relay trips it disconnects the faulty circuit, and at the same time shuts down the motor booster set. If such should occur during the charging of the cells, these relays can be electrically re-set by reclosing the small snap switch used for starting. A similar snap switch is provided for disconnecting the starting gear when the charging of the cells has been completed.

The whole of the control operations outlined above are made outside the shelter in which the switchgear is enclosed, the control panel consisting of a small junction box, conveniently placed, containing the stopping and starting switches, field rheostat handwheel, and necessary terminals for connecting up the charging plugs and cables from the vehicle to the charging switchgear, these plugs and receptacles being designed to comply with the requirements of the Electrical Vehicle Committee.

ELECTRICAL HEATING AND COOKING.

A paper on the above subject was recently read to the members of the Birmingham and District Electric Club by Mr. C. Scott. The writer said that for the past four years electrical heating and cooking had been serious competitors for older methods to meet, and there was no doubt that the invention of the nickel-chrome resistance alloy had been of the utmost importance in aiding the development of the apparatus. Previous to this discovery there was no common metal which could be safely run at a bright red temperature for any length of time when exposed to the air; consequently, the most popular electric heater, the electric fire, could not have existed without nickel-chrome wire. To be successful the heater must have the appearance of a red-hot fire to appeal to the eye, a fairly free air circulation to warm the air in the room, and sufficient heat radiation to warm any person standing near it by radiant heat alone. The lamp radiator was being gradually ousted by the electric fire, because, however good it was for warming anything placed directly in front of it, it seemed to take a long time to warm a room. The convector had also largely been displaced by the electric fire, because no warmth was felt until the whole of the air in a room was warmed perceptibly, and this was rather a slow process.

To be a commercial success the electric heater must be reliable, inexpensive to maintain, and low in first cost. The terminals should be heavy, and placed in a convenient position; the amount of wire used in the element should be as large as possible, and an earthing terminal should be provided. As on most electric heaters the switches were near

the ground, a tumbler switch was more convenient than the rotary type, and although the tumbler was more often operated by the foot than the hand, a good switch would stand this treatment quite well.

The coal fire was the cheapest form of heating, while gas and electricity were about equal, but there were many advantages which electricity had, the value of which was hard to express in money. A great advantage of the electric fire was its portability; this enabled two or three fires to do duty for a house, whereas the gas fire must be fixed because of its weight, pipework, and flue. A rating giving the best results was 1.5 watts per cu. ft.; this would give a temperature rise of 12 deg. in one hour, and half this consumption would maintain the temperature.

The chief points to be considered in electric cooking were reliability, low first cost, and low running costs. Reliability was largely a matter of design. For good and economical cooking the heat should be evenly distributed in the oven, yet the elements should be arranged so that the cook could make any portion of the oven hotter than the rest. The terminals should be heavy, and the elements should be easily replaced, and cheap to renew. Connections in the oven casing should preferably be of strip, and all screw connections should have locknuts. The position of the heating elements was important; bottom heating only did not give good browning on the top of pastry. Top and bottom heat was better, and when used in an oven which was broad in proportion to its height, was quite good; but when the oven was of ordinary shape, that was with a ratio of height to width of 3 : 2, the best results were undoubtedly obtained by the use of side elements. The whole of the interior of the oven should be vitreous-enamelled, including the shelf and shelf racks. The loading of the elements should be enough to raise the oven to a cooking temperature in 25 to 30 minutes, and a temperature of 350 deg. should be maintained by one-third heat. The temperature of the elements had an important effect on cooking. It was necessary to get direct radiation on to pastry and meat to ensure a good colour, and this could only be obtained by running the elements at a temperature giving the correct proportion of radiant and convected heat to suit the oven. Too much radiant heat would brown the outside without cooking the inside, while too low a temperature on the elements would tend to give tough pastry of poor colour. At present the rotary switch was most favoured by designers, but the writer had used tumbler switches with first-class results, and had had a switch of this type rated at 10 amp., breaking 25 amp. at 230 volts 20 to 30 times daily for three months. Of course, none but the best switches would stand this test. It was advisable to fit a fuse on every circuit, otherwise a faulty element would render the whole cooker useless. The screwed plug type of fuse seemed ideal for domestic purposes, its only defect being the cost of replacements. The top plates should be machined with a fairly coarse cut, and on no account should they be ground. There was no fear of mica disintegrating if the right mica was used, and the element assembled on the top plate under pressure. The writer had had three hot-plates run at a cherry red for over 4,000 hours, and at the end of that time the mica, 5 mils. thick, withstood 1,200 volts applied for 30 seconds. There was no doubt that electricity at 1d., or even 1½d., a unit compared favourably with gas for all oven work, and when current could be purchased at 1d. a unit or under a complete cooking outfit would not cost more to run than the corresponding gas cooker. In addition, there was the unchallenged superiority of the results obtained in an electric oven due to :—

1. The absence of the products of combustion.
2. The temperature being under better control.
3. The retention of the meat juices.

It was a fact that the usual shrinkage in a gas or coal oven was not less than 25 per cent., while in an electric oven this could easily be reduced to 12½ per cent. Considering the oven alone, when full heat was on there was not much difference between the costs for gas and electricity. Full heat was only used for running up to cooking temperature, which was only for a small portion of the time the oven was in use. While cooking was actually going on the electric oven was costing 50 per cent. less than the gas cooker. Obviously, then, although the figures given are based on a ½d. per unit tariff, electricity for roasting was equal to gas at 2s. 3d. per 1,000 cu. ft. when the charge per unit was 1d.

WAR ITEMS.

Exports to China.—The "London Gazette" for May 29th contains further names of persons and bodies of persons in China and Siam to whom exports may be consigned.

After-the-War Trade Policy.—The following have been appointed members of Lord Balfour of Burleigh's Committee on Commercial and Industrial Policy in place of others who are now members of the Government :—Sir Charles Henry, Bt., M.P., Mr. J. A. Roxburgh, Sir William Pearce, M.P., Sir William Priestley, M.P., Sir Archibald Williamson, Bt., M.P.

Sulphuric Acid.—The Minister of Munitions has issued a new Order relating to the manufacture, supply, and price of sulphuric acid as and from June 11th. It will be found in full in the *London Gazette* for May 29th.

Trading with the Enemy.—The "London Gazette" for May 25th contains further lists of persons or bodies of persons in the following countries with whom trading is prohibited :—Argentina, Brazil, Chile, Netherlands, Peru, Spain, Sweden, &c.

Coal Shortage in Denmark.—The "Times" states that many Danish factories have been compelled to cease work owing to lack of coal, and thousands of workmen are out of employment. The theatres are open for only a few hours a week, lighting in the streets is completely stopped, and railway traffic, already cut down to 42 per cent., will be still further restricted.

Enemy Works Destroyed.—According to the "Weser Zeitung," there has been a destructive fire at the Wolfram lamp factory at Lechhäusen (Bavaria). The main building and a number of adjoining stores were destroyed.—*Times.*

Part of the Kahlbaum chemical works at Adlershof, near Berlin, has been destroyed, and a number of persons were injured by an explosion there last week.—*Times.*

New Lighting Order.—With a view to checking the consumption of gas and electricity for certain forms of unnecessary lighting, the Home Secretary, after consultation with the Coal Controller, has made an Order prohibiting altogether the use of sky signs and other illuminated advertisements, and lights outside or at the entrances to shops or theatres, kinemas, and other places of amusement, excepting such as may have been approved by the police as necessary for the safety of the public. The prohibition applies at all hours, before or after dark. The Order also prohibits the retention of the interior lighting of shop windows after the shops are closed for the serving of customers.

Industrial Problems After the War.—The "Times" states that the Government propose to make novel use of the Reform Bill in their scheme, now well advanced, for the reconstruction of industry after the war, and especially for the transition of factories from war work to civil work. "It is proposed to insert in the Bill a clause enabling local registration officers, in compiling lists of voters, to ascertain the nature of the employment of each voter before the war. These returns will be tabulated in each district. At the same time a branch of the Ministry of Munitions has collected statistics from 22,000 firms in the engineering and allied industries of their prospective labour requirements. In this way there will be available lists of the men required by firms to carry out their peace contracts and of the labour reservoir on which they can draw. The Reconstruction Committee are preparing lists of public contracts interrupted by the war, as well as of those which will have to be put in hand immediately peace is declared. These will be pooled among firms according to their capacity."

America and British Colonial Trade.—From the "Journal of Electricity" (San Francisco), May 1st, we quote the following extract :—

"The Electrical Review, of London, recites the fact that strong resentment on the part of British firms in Australia is being aroused by the extraordinary preference given to foreign manufacturers when material for construction is wanted. The procedure is said to exhibit such a bias in favour of American manufacturers that all others are practically excluded from consideration. While ever-increasing commercial and engineering relations with our Pacific neighbours is exceedingly desirable, still no true American would want this trade for an instant unless devoid of bias, and winning its entrance on service and quality alone."

We appreciate the sentiment expressed by our contemporary. We are confident that the mobilising of American resources with a view to hastening the defeat of the Hun will promote an increasing friendliness with our trans-Atlantic cousins for after-the-war trade co-operation.

Women in Engineering.—We referred some weeks ago to a very impressive and effective exhibition of official photographs and samples of women's work that was organised by the Labour Supply Department of the Ministry of Munitions, and was held at the Royal Colonial Institute, in London. It will be remembeerd that the collection illustrated the various types of work upon which women are employed in engineering and other industries on munitions of war. On Wednesday last the second of the series of exhibitions was opened, and it shows a still greater variety. This time Bristol is the centre, and the Lord Mayor of that city performed the opening ceremony. The exhibition will remain open until June 5th from 10 a.m. to 6 p.m. It is being held at the Royal Colonial Institute, Whiteladies Road, Bristol, and we are sure that a visit to it will well repay those connected with engineering and munition labour questions who may be within fairly easy reach. Most of our readers are already well versed in regard to the excellent adaptability that the women of the nation have shown in connection with such activities, but even to such the variety of the collection will, we feel sure, convey some new information worth possessing at the present time regarding the responsible work for which they have proved their capacity.

"Be a Potatriot."—Under this heading, the "Electrical Age" (U.S.A.) urges its readers to take their share in the increased production of foodstuffs. Potato sowing plans by private householders are being proceeded with energetically in the States, and we gather that central stations there are also taking up the gardening idea. "There is much unoccupied land adjacent to company buildings where amateur farmers have easy access, and where crops are readily protected from theft. Certainly a well-tended garden looks better than a cinder-covered yard, and the improvement costs the company nothing. Indeed, it is of distinct benefit, as putting the central station in its rightful place as a leader in a project in which the community is asked to join." Oh where, and oh where is our own Electrical Development Committee gone? What untold possibilities might otherwise lie awaiting us in the form of central-station crops. Pity we are all so short-handed—or short-sighted. Tomatoes in the boiler-house, even chestnuts in the staff room—perhaps.

Exemption Applications.—At Aldershot, on May 22nd, the Aldershot Traction Co. defended a military appeal against conditional exemption held by the superintending engineer, Mr. E. A. Fager, who is 42, and in Class B 1. The Tribunal decided that Mr. Fager was in a reserved occupation, and the exemption was confirmed.

Mr. H. B. Atkinson, electrical engineer, Morecambe, aged 29, has had his temporary exemption extended by the Morecambe Tribunal till August 31st. He had from 800 to 900 customers on the books. He was told he must confine himself to doing electrical work.

At Rochdale, temporary exemption to July 31st was given to Mr. J. Fozard for S. Standring (37, C 2), electrician, and to the Tramways Committee for W. T. McCaul (41, C 3) and J. Hird (37, Class A), motormen.

An application by the Military Representative against the decision of the Heywood Tribunal, granting conditional exemption to June 15th in the case of an employé in the Corporation electricity department, was successfully made at the Salford Appeals Tribunal. The certificate was altered to final exemption to the date named. Judge Mellor, who presided, said a trade card had been produced, but the Appeals Tribunal, acting on instructions, had decided not to recognise such cards. They could be easily obtained, and the Tribunal were not going to be parties to the scandal of sending men of 40 to the Colours and exempting Class A men of 26. If the card would over-ride their decision, that was a matter the parties must fight out for themselves.

At Faversham, an appeal was made by the Military against exemption held by Mr. Colin Walton (31), who has, amongst other duties, charge of the electrical plant at the sewage works. The appeal was disallowed, and the exemption confirmed.

Renewed exemption was applied for, at Nuneaton, by Mr. G. H. Patrick (28, in Class C 3), electric light and power contractor, and he was exempted under a munitions substitution order.

P. MacAlpine (37), fitter and electrician, with the East Surrey Traction Co., has been given three months' temporary exemption by the Reigate Tribunal.

On the appeal of the Dorking Electric Supply Co., final exemption until June 30th has been given to J. Rawlinson (34), electrician.

Berwickshire Appeal Court has refused exemption to Mr. J. G. Graham (36), electric light fitter, of Newton Don.

On the recommendation of the Advisory Committee, Rochdale Tribunal has given temporary exemption until July 31st to W. T. McCaul (41, in Class C 3) and J. Hird (37, Class A), motormen on the Corporation tramways; and to S. Standring (37, Class C 2), electrician, appealed for by Mr. J. Fozard.

At Hastings, the Tramway Co. appealed for a brake and trolley examiner and a switchman, and it was agreed that the cases should be referred for substitution.

Herts. Tribunal has refused an appeal for exemption to S. C. Salmon (36), of Barnet, clerk to an Electric Supply Co., and he is to join up on June 15th.

A military appeal has been allowed against exemption held by R. H. Lerwell, charge engineer at the works of the Ilfracombe Electric Light Co.

Bradford-on-Avon Tribunal have granted three months' exemption to Mr. Malcolm Stirling (40, in Class C 2), electrical engineer at the Wilts. County Asylum, Winsley.

At Melton Mowbray, Mr. J. F. Montague, of Cold Overton Hall, appealed for T. E. Smith, electrician, responsible for the supply of current and the upkeep of about 400 lights. The Tribunal granted conditional exemption.

Australia and Electrical Contracts.—At a meeting of the Adelaide Chamber of Manufactures, held toward the end of March, consideration was given to a letter from the Secretary of State for the Colonies regarding the handicaps under which the British electrical industry is at present labouring owing to the war, and a resolution was carried recommending that all contracts be suspended until British manufacturers are again in a position to tender for oversea work.

REVIEWS.

Electric Switch and Controlling Gear. By C. C. GARRARD, Ph.D., M.I.E.E. London: The *Electrician* Printing and Publishing Co., Ltd. Price 15s. net.

This is a specialised work dealing with appliances and devices for the control and regulation of pressure and current, a subject in which the author has a very extensive experience. To produce a satisfactory book on such a subject is undoubtedly a difficult matter, since so many of the points which must be dealt with are of a controversial nature, and anything approaching finality is far from being reached in regard to the subject generally.

The book is divided into eight chapters, the first being devoted to a study of the materials used in the construction of switches and switchboards, and to considerations in regard to specifications and manufacturing methods. The next section deals with appliances for breaking electrical circuits, and includes a consideration of high and low-tension switches and fuses. Particular stress is laid on the fact, recently the subject of much attention on the part of operating engineers, that the real difficulty in designing a switch is not to arrange for it to carry (or break) the normal current, but to arrange for it to break the much larger currents which occur under fault conditions. As is well known, high-tension switches are often weak in this respect, and in some cases special means have been taken to keep down the current flowing under short-circuit conditions.

Chapter III is chiefly concerned with devices for cutting out faulty cables and machines, and the section dealing with the application of time elements to overload relays is of particular interest. Reverse power relays and the more recent systems of balanced protection are also adequately considered.

Field regulators, both hand and automatically-operated, are next dealt with; in this section it is noticed that the carrying capacity of a wire (the material, temperature rise, and environment being fixed) is said to vary as $d^{1.5}$. As a matter of fact, in the case of fusing currents of wires (a very similar problem) the index 1.5 is not correct; it would be interesting to know if there are corresponding variations, as seems probable, in the case under notice.

The section dealing with motor starters seems rather unbalanced; there are few schemes of connection for shunt motor-starters, and difficulties with no-volt releases, particularly with variable-speed motors, are certainly worth discussion; the problem of the "inching" starter is also of considerable interest. Starters for induction motors are dealt with in a much more satisfactory manner.

Switchboards, for high and low-tension circuits, are fully considered from the point of view of diagrammatic arrangement, and also from the standpoint of mechanical and electrical construction. Particular attention is paid to the switchgear for appliances which have come into use in recent years, as self-synchronising rotary converters and phase advancers. In regard to the former, one very interesting arrangement does not seem to be mentioned: that in which the same auxiliary machine is used both as the starting motor and, subsequently, as the synchronous booster. In this section there is also included an interesting account of current and pressure transformers for use with instruments and relays.

In the concluding chapter, the protection of circuits against damage from pressure rises, both internal and external in origin, is considered; in particular, the numerous ways in which internal causes may produce pressure rises, a difficult subject, are clearly explained.

Several appendices dealing with the regulations concerning switchgear issued by various controlling authorities are included, perhaps the most useful being that concerned with extracts from the United States National Electrical Code.

Dr. Garrard can certainly be congratulated on his book, which must have entailed very great labour in collection and compilation. The half-tone diagrams have been well reproduced, and the line diagrams clearly and simply drawn. It seems, however, a mistake to have taken a clockwise direction for the rotation of the vectors in vector diagrams, especially since the fact is not explicitly indicated in each diagram. In addition to serving as a text-book to engineers and students generally, it can be recommended with every confidence as a reference book to central-station and transmission engineers and to those engaged in the manufacture of high-tension switchgear and machinery.

The Principles of Electrical Engineering and their Application. By GISBERT KAPP, M.I.C.E. London: E. Arnold. Price 15s. net.

The electrical student of the present time appears to be a most fortunate individual; he has the choice of numerous works of reference, both general and specialised, and the book now before us presents the subject under discussion in still another light.

Some works are highly mathematical treatises, while others give but a vague and popular presentation of the matter set forth. Prof. Kapp's effort, however, steers a mid-way course;

it is by no means a book to be lightly treated, but, at the same time, there is no reason for the prospective reader, who is assumed to have had an education involving at least a nodding acquaintance with higher mathematics, to be dismayed; although the theory is mathematically treated, all steps are carefully set out, so that there should be no difficulty in following the reasonings. As the volume in question, being the first of two, deals with principles only, it must not be expected that the contents may be digested save at the expense of time; but one's mind attains a sense of satisfaction after it has been perused, and there is a feeling that the time so spent has been time well spent—it being a book of undoubted interest even to the general engineer. For the student at technical school or college it should be looked upon as a text-book setting forth the principles of electrical knowledge so that their application becomes almost nature to him, while for those whose opportunities have not been so favourable, it is a mine of untold wealth. It should also enable the captains of industry to readily appreciate technical points brought before their notice, and so assist them in their judgments.

The matter is disposed of in logical sequence, opening with a chapter on conductors, Ohm's law forming the basis of the arguments. The measurement of resistance includes accounts of various bridges, and here one is immediately struck with the diagrams and descriptive matter which enable the minor details necessary to render success complete to be appreciated. Generally the possibilities of the potentiometer are but slightly known, but the chapter devoted to potentiometric measurements should assist those who consider its use to be very limited, to value its wider applications. The graphical methods for combining resistances and the design of resistance steps are features of the section dealing with applications of Ohm's law, and other principles illustrated are dealt with in a most explicit manner.

The author proceeds to discuss the distribution of continuous currents, several general examples being worked in detail; their similarity to the determination of bending moments was explained, illustrating how results may be easily determined by graphical methods. The subject of boosters is included in this chapter, and Dr. Kapp's modesty in this connection is most marked. Consideration of circuits for electric tramways introduces the Board of Trade rules, while the pages devoted to the three-wire system prove to be of more than passing interest.

In a work of this nature one does not usually expect small but practical details to be discussed at such length as the author devotes to the testing of insulation resistance, and the reading under this heading should be of immense value to the general engineer, who, at some time or other, has to deal with such tests.

The next subject to take our attention is that of elementary electrostatics, which leads up to the consideration of capacities, to which much space is devoted. A chapter on applied electrostatics follows, and the principles set out in the previous pages enable one to appreciate the more practical questions now involved; to one interested in the study of cables from a general view-point these portions of the work should be of great value. A section allotted to magnets follows, the mathematical and physical conceptions being concisely treated, so that when one comes to the subject of electromagnetism the grounding given makes it possible to readily understand the arguments then presented, and there is no doubt that a careful student of the mathematical reasonings will find much capable of being turned to good use when the consideration of designs is necessary.

Chapter XI is devoted to elementary electrodynamics, and here again, we find the same logical and clear manner of handling a subject as is shown in the previous pages, the mathematical side being given fully though simply, the relation between the various units employed is next investigated, useful tables being given after original discussion.

There are few so competent as Dr. Kapp to deal with the subjects next treated, viz., electromagnetic measurements and the testing of the magnetic qualities of iron. At first the more usual forms of instruments are briefly enumerated; the principles of the galvanometer are dealt with thoroughly, so that one proceeds to those paragraphs relative to iron testing with an intimate knowledge of the capabilities of the apparatus used. The reader is also enabled to form a concrete idea of the importance of hysteresis, and the pages touching upon this should be of great concern to the designer, embryo or otherwise. Before passing on to the second of the two chapters, the author's bridge method of finding inductance is mentioned amongst others, and is dealt with in a characteristic way. After a section referring to the objects of testing iron, we are introduced to the subject of permeameters, and here again Dr. Kapp's versatility becomes apparent, and one cannot but admire his simple mechanical devices for overcoming the difficulties appearing in the experimental work of others. The testing of thin sheets next claims attention, and once more interest is keenly held, especially by the final dissertation in which the original work of the author asserts itself. One who has attempted the testing of sheet iron by some of the various methods will appreciate the ease and simplicity of the test in question, and the working out of results cannot fail to please a professed student. The final chapter is devoted to the theory of alternating currents, and forms one of the clearest accounts anent this subject that we have seen; vectorial representation is carefully explained, and practical details are alluded to in such a manner that it is with genuine regret that one comes to the end. A good general index and an index to formulæ complete this section of the work.

The general impression gained is one of thoroughness, combined with a facility of expression which arouses a keenness and sustained interest, and there is no doubt that a reader of this work is sure to look forward to the companion volume on "Applications" from the same author, which is promised for the future. Mistakes are few and far between, and the paper and type well chosen, so that the two together form a work which will last and be a handy means of general reference.

Atoms. By Prof. JEAN PERRIN. London: Constable & Co., Ltd. Price 6s. net. (Translated from the fourth revised edition.)

We are in some little danger in these days of taking a somewhat lop-sided view of the atomic theory in general, and of the structure of the atom in particular, owing to the great amount of attention directed of late years to the various phases of radioactivity. We are apt to forget the great amount of work formerly devoted to these subjects—work which, for accuracy and brilliancy, compares quite favourably with anything recently done. The little book under review comes as a timely corrective; for in its 200 odd pages it sets out in brilliant style the case of the atom from our first rudimentary conceptions of it as the ultimate irreducible particle right down to our latest pictures of it as a whirling system of electrons. That is to say, the discoveries of the last 20 years, important and epoch-making as they are, are nevertheless apt to bulk too large because of our nearness to them, and this book endeavours to give them the kind of perspective they will eventually assume in the eyes of our descendants.

The author commences the book with a long chapter on chemistry in relation to the atomic theory, in which he deals thoroughly with such things as Avogadro's hypothesis, atomic coefficients, gramme molecules, molecular structure, valency, stereochemistry, solution, &c. The chapter includes a couple of interesting paragraphs dealing with the upper limit of molecular size. The author states that he has satisfied himself that a solution of fluorescein containing one part in a thousand, illuminated at right angles to the microscope by a parallel beam of very intense light, still shows a uniform green fluorescence in volumes of the order of a cubic micron; from which it follows that the mass of the bulky fluorescein molecule, which is 350 times as heavy as the hydrogen atom, is certainly less than the one-thousandth part of the mass of a cubic micron of water. The sum total of the researches on thin films shows that the different atoms are certainly less than a hundred-thousandth (perhaps a millionth) of a millimetre in diameter, and that the masses even of the heaviest (such as a gold atom) are certainly less than a hundred-thousandth (perhaps a hundred-millionth) of a trillionth of a gramme.

Chapter II is on molecular agitation, and deals with molecular speeds, molecular rotations and vibrations, molecular free paths, &c.

The next three chapters are perhaps the most important and most noticeable in the book, and will repay careful study. They deal in great detail with the Brownian movement. From the time when the English botanist Brown in the year 1827, just after the introduction of the first achromatic objectives, examined a collection of small particles suspended in water, and noticed that each of them, instead of sinking steadily, was jumping about in a lively and haphazard way, up to the time of the latest and most refined researches, the author takes us. Like most really great events, the original discovery attracted little attention. The motion of the particles was thought to be due to currents, vibration, temperature variations, and so on. But most careful experimentation has discredited any such theories. It was soon discovered that the smaller the grains the more active the agitation, while their nature exerts little influence. In the same fluid two grains are agitated to the same degree if they are of the same size, whatever the substance of which they are composed, or whatever their density. The Brownian movement never ceases. It is seen in the liquid inclusions that have remained shut up in quartz for thousands of years. We have therefore to come to the conclusion that it is concerned with actual molecular motions.

The author details the considerable researches he has carried out on the Brownian movements. He describes the preparation of the emulsions used, the methods of determining the density and volume of the granular material, and the methods of observing an emulsion and of counting the grains. He sought to discover the law according to which the concentration of the grains decreases. He found that the grains obeyed a law like the atmosphere under gravity. Thereafter an investigation was carried out to discover if the rarefaction law led to those values of molecular magnitudes that we look for. After most exhaustive research the author found that he deduced the very numbers that had been obtained from the widely different point of view of the kinetic theory.

Einstein's theory is then given, dealing with the translational and rotational Brownian movement, and the author

describes, with the aid of diagrams, the long and involved research he carried out to test it.

Chapter VI is on light and quanta, and considers black bodies, the composition of the light emitted by such bodies, how the radiation emitted by a black body enables us to determine the molecular magnitudes, rotational velocity in a molecule, and so on, while the last two chapters deal with the atom of electricity and the genesis and destruction of atoms.

The book is a valuable epitome of the greater part of our knowledge of the atom as such knowledge stands to-day.

TELEPHONE WIRES IN STREETS.

[FROM OUR LEGAL CONTRIBUTOR.]

FROM time to time complaints are to be found in the newspapers as to the inadequacy and inefficiency of the telephone service. It is easy to rail at any public department; but before deciding whether there is any good ground for complaint it is necessary to consider the powers with which the particular department is invested, and the limitations which the Government has placed upon the exercise of those powers.

Those who are responsible for the telephone service are in this difficulty—each new subscriber involves additional capital outlay. He adds, indeed, another complication to an already complicated system. Into that, however, it is not proposed to enter. We merely desire to draw attention to one of the difficulties which beset the Postmaster-General when he is asked to extend his system for the benefit of a new subscriber. He may have to lay a new overhead wire. Can he do this? Sec. 12 of the Telegraph Act, 1863, provides that: The company (that is to say, the Postmaster-General) shall not place a telegraph over, along, or across a street or public road, or a post in or upon a street or public road, except with the consent of the body having the control of such street or public road, and where a public road passes through, or by the side of, any park or pleasure grounds, and where a public road crosses, by means of a bridge or viaduct, or abuts on any ornamental water belonging to any park or pleasure ground, and where a public road crosses or abuts on a private drive through any park or pleasure grounds, or to any mansion, the company (*i.e.*, the P.M.G.,) shall not, without, or otherwise than in accordance with, the consent of the owner, lessee or occupier of such park, pleasure grounds, or mansion, place any work above ground on such public road.

Sec. 13 of the same Act provides that:—

"Where any landowner or other person is liable for the repair of any street or public road (notwithstanding that the same is dedicated to the public), the company shall not place any work under, in, upon, over, along, or across such street or public road, except with the consent of such landowner or other person, in addition to the consent of the body having the control of such street or public road, where under this Act such last-mentioned consent is required: provided that where the company place a telegraph across or over any street or public road, they shall not place it so low as to stop, hinder, or interfere with the passage for any purpose whatsoever along the street or public road."

"The term 'street' means a public way situate within a city, town, or village, or between lands continuously built upon either side, and repaired at the public expense, or at the expense of any turnpike or other public trust, or *ratione tenuræ*, including the footpaths of such way and any bridge forming part thereof.

"The term 'public road' means a public highway for carriages, being repaired at the public expense or at the expense of any turnpike or other public trust or *ratione tenuræ*, and not being a street, including the footpaths of such public highway, and any bridge forming part thereof, and also any land by the side and forming part of such a public highway, but not including a railway or canal."

The question then arises as to what is a "city, town, or college," and it seems to be a matter of fact upon which divergent views may be held. "Town" in modern Acts of Parliament is not restricted to its legal meaning, but is expanded popularly, and means the space which, for the time being, is covered by, or occupied as accessory to, houses collected together in a mass, and in sufficient number to be ordinarily designated as a town, and includes unbuilt on lands that may lie within the ambit of such collected mass of houses (Elliott *v.* S. Devon Railway (1842), 17 L.J., Ex. 262). In the case just cited it was held that the word "town" meant the space on which the inhabitants have permanently collected their dwellings so near to each other that they may be reasonably said to be contiguous. It includes all open spaces surrounded by a continuous line of houses; and, *semble*, all open spaces occupied as mere accessories to the congregated dwelling houses although not so surrounded. In a later case (The Queen *v.* Cottle and Others (1851), 20 L.J.M.C., 162), a judge who told a jury that a town was to be taken in its popular sense of a collection of houses, and that they were to consider whether the spot was so surrounded by houses that the inhabitants might fairly be said to dwell together, the fact of the houses being separated by gardens not preventing them from lying together, was held to have given a proper direction.

In one case it was for the Court to decide whether Teddington was a town. In the London and South-Western Railway *v.* Blackmore (1870), 39, L.J.N.S., Ch. 712, the question was whether two plots of land situate near the High Street, Teddington, were in a town. At that time Teddington contained two churches, two chapels, two post offices, 450 inhabited houses and 2,250 inhabitants, within a radius of 30 chains of the plots in question. The Lord Chancellor said:—"With regard to this particular place where the land is situate, which has been offered for sale by auction, it appears to me, I confess, that there is no pretence for saying that that particular land is situate in a town . . . . There is on one side of it a small row of houses, built by some building society or freehold land society . . . with that exception, and the exception of the house of the plaintiff in this suit, who has built a house on the property which adjoins the railway property, there is really nothing which can be said to be occupied by persons in such a manner as to constitute continuous residence or anything like it in any reasonable sense that would induce their Lordships to say that the land is 'situate within a town.'"

"In my opinion," said Hawkins, J., in Deards *v.* Goldsmith and Wife (1879), 40 L.T., 328, "a town grows with the buildings, and wherever it can be said that the latter have advanced to such an extent as that that which was formerly without is now within the 'town,' the exemption will apply to such newly-added part of the town."

The borough or urban sanitary boundary is not conclusive, as it might run through fields (see per Cairns, L.J., in Carrington *v.* Wycombe (1868), 37, L.J., Ch. 213, at p. 217).

Even assuming there is no difficulty with any private owner of property, the Postmaster-General may find it difficult to know with whom he is to negotiate. Thus it might be thought that the local authority obviously had some say in the matter. But this is not always the case. For instance, in the recent case of the Postmaster-General *v.* Hendon Urban District Council, the Postmaster-General applied to an Urban District Council for their consent to his placing telegraphic lines in, upon, over, along or across urban streets or public roads in their district. The Council objected that they were not a body having control over the roads within the meaning of Sec. 13 of the Telegraph Act, 1863. It was held, following Redhill Gas Co. *v.* The Reigate Rural District Council (1911), 75, J.P. 358, that the District Council had not the control over the roads, within the meaning of the section, and were not, therefore, entitled to give consent.

This case leaves the question to whom the Postmaster-General was to apply entirely open. He was probably put to considerable expense in order to ascertain who he was *not* to apply to. If the Legislature thinks it right to put these burdens upon him, it is small wonder that the telephone system is expensive.

Japanese Exports.—Japanese exports to the United States have doubled since the beginning of the war.—*Times.*

BUSINESS NOTES.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. LV. No. 266, May, 1917. This issue contains the following papers:—"Wayleaves," by Mr. C. Vernier; "Engineering Specifications," by Mr. J. Shepherd; and "A Concentric Standard Dynamometer Wattmeter for Heavy Currents," by Mr. A. E. Moore.

"Advanced Text-Book of Magnetism and Electricity," in two volumes. By R. W. Hutchinson. London: University Tutorial Press, Ltd. Price 8s. 6d.

Plant for Sale.—The Oldham Corporation Electricity Committee has for disposal two Willans-Siemens 740-KW. sets, shunt-wound, 450-480 volts. Particulars are given in our advertisement pages to-day.

Patents and Alien Enemies.—Licences have been granted by the Board of Trade in respect of Patent No. 25,101/12 granted to Bauer, to Messrs. Fredk. R. Butt & Co., Ltd., and in respect of patent No. 26,941/06 granted to Meirowsky, to H. Clarke (Messrs. Clarke & Co.).

Catalogues and Lists.—MESSRS. LAURENCE NORRIS AND CO., 56, Kingsway, London, W.C.—Tabulated quantities and sizes of ball bearings offered for sale.

B.E. CO. (OF LONDON AND BIRMINGHAM), LTD., Mansion House Chambers, Queen Victoria Street, London, E.C.—Price leaflet of Hendon drawn-wire lamps.

MESSRS. W. SANDERS & CO., Falcon Electrical Works, Wednesbury.—36-page illustrated catalogue, describing their new patent Home Office fuseboard and Home Office ironclad switch.

Trade Announcement.—MESSRS. ASHDOWNS, LTD., have removed from Northfleet to Crete Hall Road, Rosherville, Gravesend.

Dissolutions and Liquidations.—BAKELITE & CO., LTD.—Sir W. B. Peat, the Controller, has applied to the B. of T. under Section 1, Sub-section (5), of the Trading with the Enemy Amendment Act, 1916, for his release.

MARINE SMOKELESS MECHANICAL STOKER CO., LTD.—A meeting is called for July 2nd, at 28, Bishopsgate, London, E.C., to hear an account of the winding-up from the liquidator, Mr. T. W. Gilbert.

Foreign Trade Catalogues.—The Commercial Intelligence Branch (Foreign Samples Section) of the Board of Trade, 32, Cheapside, E.C., has prepared an Index of Foreign Catalogues issued by German and Austro-Hungarian firms. These catalogues have been collected by the Branch from all parts of the world, and the Index (60 pages) contains two sections—one a Subject Index to Manufactures, in which electrical goods figure very considerably, the other being an Index of Firms by whom the catalogues were issued. As might be expected, the publications of the A.E.G., Siemens, Bergmann, and other such concerns in the collection are very numerous. The catalogues themselves may be seen by our manufacturers at the above address, but in certain cases where it is not convenient for manufacturers to inspect them in London they will be lent for short specified periods, so that firms may have an opportunity of studying them at their own works. We believe that in organising this collection the Branch has performed a valuable piece of war trade work, which cannot fail to be of both real interest and practical service.

LIGHTING AND POWER NOTES.

Australia.—Representatives of Boolaroo and Speers Point recently waited on the manager of the Sulphide Corporation works at Cockle Creek to discuss a proposal for the electric lighting of those districts. Particulars of the cost of wiring, also lighting and power costs were obtained, and it was decided to canvass the district in order to obtain a guarantee of 200 consumers.

The Southport (Queensland) Council has finally adopted the agreement for the electric lighting of the town; the Barcaldine (Queensland) Council has decided to borrow £6,000 to complete its electric lighting scheme.

A report has been submitted by the Federal Standing Committee on the proposal to erect a power house at the Flinders naval base, at a cost of £41,350, which course is now recommended.

Barrow-in-Furness.—YEAR'S WORKING.—The annual report of Mr. H. R. Burnett, the borough electrical engineer, for the year ended March 31st last, shows that the total output sold was 13,429,260 units, as against 13,806,254 in 1915-16, which year, it may be remembered, showed a great increase on the previous year's total of 3,597,410 units. The slight reduction in output was due to a private power house coming into operation, but the reduction through this cause was largely counterbalanced by the increased requirements of other consumers. The revenue increased to £63,114 from £59,208, and, after meeting operating expenses, the gross profit was £23,289, while the net profit, after payment of interest and sinking fund, was £11,223, as compared with £12,804 in the previous year. The increased cost of coal during the year represented £2,700, while rates and taxes were on an increased scale. It may be noted that during the year the output for power and heating totalled 11,448,800 units, or 85 per cent. of the total, and produced £41,384 of the total revenue of £63,114, the average price obtained for this supply being ·867d. per unit. Private lighting and domestic supply increased by 19 per cent., while power and heating supplies (other than to the large consumer previously indicated) increased by 26 per cent. Of the total capital expenditure of £179,231, some £93,607, or 52 per cent., has been offset by capital repayments, revenue contributions to capital and to the renewals fund.

Mr. Burnett draws attention to the necessity of accumulating as large a sum as possible, with a view to improving the efficiency of the undertaking at the earliest possible moment, and thus meeting the demand for cheap power. It may be noted that the results recorded since the war started have been obtained without increasing the charges, and that the average price obtained for the whole supply during 1916-17 and 1915-16 has been 1·11d. and 1·02d. per unit, power and heating supply figuring at ·867d. and ·775d. per unit respectively. The total working costs during these years were ·712d. and ·605d., the maximum loads being 3,625 KW. and 3,905 KW., and the load factors 42·3 and 40·36 per cent. respectively. During the year a 960-KW. rotary has been installed at the works in place of a smaller set removed to a sub-station; new ash plant has been installed, and plans prepared for new boiler plant. About 300 connections were made to the mains, including 100 workmen's houses, and the apparatus on hire reached 1,250 pieces, including motors, radiators, irons, kettles, ovens, hot-plates, arc lamps, &c. The total connections amount to 8,905 KW., and include over 3,000 H.P. of motors.

Bingley.—The accounts of the Council's electricity undertaking for the year ended March 31st show a deficit of £333; there has been extraordinary expenditure amounting to about £550.

Birmingham.—RATE RELIEF.—The accounts of the electricity supply department show that the amount available for allocation to the rates will be £27,700, instead of the £25,000 promised. The amount handed over last year was £25,498.—*Birmingham Post.*

A fire occurred on Saturday night at the Smethwick power station of the Shropshire, Staffordshire and Worcestershire Power Co., due to a short circuit, and resulted in the shutting down of the station. It was anticipated that the full supply would be available on Wednesday.

Bolton.—RATE RELIEF.—The Electricity Committee has decided to allocate £2,000 in aid of the rates, instead of £1,500 as estimated at the beginning of the year. The Committee has passed a resolution congratulating the electrical engineer, Mr. W. J. H. Wood, on the successful running of the new generating station at Back-o'-th'-Bank.

Bridlington.—YEAR'S WORKING.—The report of the deputy electrical engineer, Mr. F. Ffrench, on the working of the electricity undertaking for the year ended March 31st, discloses an unfortunate situation, due, of course, to the prevailing conditions.

The output sold, amounting to 270,220 units, compares with 460,734 units in the previous year and 535,000 units in 1913-14; while both revenue and expenditure fell off as well, the financial charges remained stationary, and in the result there was a deficit of £1,321, or nearly £1,000 in excess of that of the previous year. The position can be gauged from the fact that the average price received was 3·55d., while the all-in costs were 6·15d. per unit, as against 2·9d. in normal times.

Bury.—The Corporation Electricity Committee, after a full discussion, has decided to allow the price of electricity to remain as at present, until the end of September, when the matter will be further considered.

Canada.—According to the *Financier*, the directors of the British Columbia Electric Railway Co. report that the Legislature has amended the clauses of the Vancouver City Incorporation Act which protected the company against municipal competition with respect to lighting and power, and after June 1st, 1919, the city will apparently have the right to compete with the company, but further particulars are expected by the next mail.

Cardiff.—PRICE INCREASE.—It has been decided to increase the price of electricity by 5 per cent., commencing from April 1st.—*South Wales Echo.*

Continental.—ITALY.—H.M. Embassy at Rome reports that the Supreme Council for Public Waters has granted concessions to three local companies for increases in water power to be derived from the River Nera in the Province of Perugia, and from the Rivers Piave and the Cordevole in the Province of Belluno. The Council is further considering a number of other applications for similar concessions, and is studying the water-power possibilities of various streams in the Cuneo and Rome districts, especially of the lakes of Albano and Nemi.

SWITZERLAND.—A circular of the Federal Council to the Cantonal Government notifies the new law relating to water-power concessions, providing that at least two-thirds of the directors of a concessionaire company must be Swiss citizens and domiciled in Switzerland and that no transfer of the concession may be made without the consent of the conceding authority, comes into operation on January 1st, 1918.—*Board of Trade Journal.*

SPAIN.—A new company has lately been formed in Bilbao, with a capital of £256,000 and the title La Sociedad Productora de Fuerzas Motrices, to establish a large hydro-electric station in the Province of Lerida. It is stated that the current generated at the new station, which is to have a capacity of 16,000 H.P., has already been contracted for by the Sociedad de Energia Electrica de Cataluna.

Croydon.—Proposed Loan.—The T.C. has considered an application for an increased supply of electricity to a local factory, at an estimated cost of £2,000. It was decided to make application to the L.G.B. for sanction to the borrowing of the amount necessary.

Darwen.—Price Increase.—At a meeting of the Electricity Committee, on May 24th, it was decided that the charges for electricity be advanced 10 per cent. above present prices.

Finchley.—Loan Sanction Refused.—The responsible authority having decided that proposed extensions are unnecessary, the L.G.B. has refused its sanction to the borrowing of £14,000 required for the purpose.

Glasgow.—The T.C. is recommended to support the movement of municipal electric supply authorities for obtaining increased representation on the B. of T. Committee on Electric Supply, and a resolution to that effect has been passed by the Electricity Committee.

The Corporation has decided that no new consumers can be connected with the electricity supply mains unless they are engaged on work of national importance.

Haslingden.—Price Increase.—The T.C. has decided to increase the charge for electricity for lighting purposes by ½d. per unit, making the price 4½d. The price of current supplied for power and heating, other than under special agreement, is to be increased 15 per cent. Councillor Waddington said that without the increase the Committee would be quite unable to pay its way, and he hoped it would be possible to bring the price back to 4d. per unit after the conclusion of the war.

Ilford.—New Plant Proposals.—In consequence of the refusal of the L.G.B. to sanction a loan of £10,000 for additional generating plant, the engineer has recommended a scheme of H.T. transmission with step-up and step-down plant between Ley Street and Grove Road sub-station, at a cost of £5,800, and tenders are to be obtained. It is reported that the results of running the electric coal wagon have been very satisfactory.

Keighley.—Yesterday the new plant at the Corporation electricity works was to be officially started up; the plant capacity now amounts to 10,000 KW.

Letterkenny.—E.L. Proposal.—The Asylum Board is asking the Urban Council to join in a scheme to provide an electrical installation for the institution, worked by turbines erected on the Lennon Falls at Kilmacrenan Bridge.

Llanelly.—The surveyor reported to the Roads Committee that in regard to the lighting account for the three quarters ended March 31st last, he had obtained a reduction of £203, which he recommended the Council to accept. The Committee decided that, as the lighting contract expired at the end of next year, to recommend the Council to open up negotiations with the company at once as to the renewal, so that the matter should be gone into thoroughly.

Llandudno.—Year's Working.—The working of the electricity undertaking for the year to March 31st resulted in a gross profit of £1,519; after allowing for repayment of interest and sinking fund charges, amounting to £3,527, there was a deficiency of £1,733, as compared with a deficiency of £1,331 the previous year.—*Liverpool Post.*

Manchester.—Rate Relief.—The budget, providing for an increased rate of 4·3d. in the £, was considered by the City Council last week. Ald. Goldschmidt, the chairman of the Finance Committee, said the increase was more than accounted for by the reductions in the proposed contributions from the trading departments. The Electricity Committee proposed to give only £16,570, as against £30,000, and the tramways £50,000, as against £100,000. The Finance Committee had passed a resolution that the Committees should be asked to make the same contribution as last year, and he thought the Council was justified in asking the Electricity Committee to provide £30,000, and moved that this be done. The discussion was adjourned for a fortnight, no decision being reached.

Stafford.—Proposed Loan.—Sanction to a loan of £8,700 for a new boiler, accessories, boiler house, &c., at the electricity works, has been applied for by the T.C.

St. Austell.—Street Lighting.—The U.D.C. has, by six votes to four, passed a recommendation from the Lighting Committee not to pay anything to the Electric Light Co. in respect of 95 public lamps which have not been used for a year.

TRAMWAY and RAILWAY NOTES.

Accrington.—Inter-Running.—A conference has been held between representatives of Haslingden and Accrington Corporations on the question of the basis on which the car-milage run by Accrington cars in Haslingden should be charged, and a new agreement for six months was come to, whilst it was decided to pay an additional ½d. per car-mile for the year ended March last. At Haslingden T.C. it was stated that the agreement was moderately satisfactory to both sides.

Ashton.—Increased Fares.—A proposal has been submitted to the Corporation Tramways Committee for raising the fares on all the routes, in order to meet the increase in working costs, and has been approved. The revision of fares on the system of the Stalybridge Joint Tramways Board is also under consideration.

Bingley.—Reporting on the local tramway service provided by Bradford, Mr. Snowden said 549,000 full 3d. fare passengers had been carried from Bingley to Bradford. The saving to the community, on the pre-war railway fare of 5½d., was £6,742, whilst on the present railway fares it was equal to £12,580. By workmen's cars in the morning men could travel the 6-mile journey for 1½d.

Dublin.—Continued efforts are being made to induce the B. of T. to take over the control of the Dublin and Lucan, and Dublin and Blessington electric lines, as is the case with other Irish electric lines.

Glasgow.—Lottery Tickets.—In view of the prominence recently given to the subject, the tramway department has issued a statement showing that since it started the sale of lottery tickets 11 weeks ago, the total receipts have been over £16,000, of which £12,500 was devoted to War Charity Funds, while over £3,000 was disbursed on pictures and War Savings Certificates, which were included among the weekly prizes.

A letter has been received from the Under-Secretary for Scotland, pointing out that the attention of the Lord Advocate has been drawn to the question of the tramway prize-drawing scheme; he desires to know what the Corporation intends to do, and says he may have to consider the desirability of taking steps to stop the drawing of prizes. A meeting of the Corporation has been called in consequence; the tramway manager, who originated the scheme, has suggested that an effort should be made to have the prize-drawing scheme legalised.

Keighley.—The employés decided to return to work on Saturday last, the Tramways Committee having refused arbitration (unless compelled) or otherwise to agree to the demand for increased pay for the women conductors. The employés are, it is understood, referring the matter to the B. of T.

Morecambe.—Proposed Electric 'Buses.—The Council is now agreed on the necessity of doing away with horse cars, but it is realised that electric cars cannot be provided during the war, and the scheme in contemplation is the purchase of electric 'buses, which might be obtainable almost at once.

TELEGRAPH and TELEPHONE NOTES.

Argentina.—A German company has applied to the Ministry of Marine for permission to establish within the City of Buenos Aires a radiographic station to communicate with the German capital. The applicants state that the station will only be used for the reception of messages. The Minister of Marine is reported to be giving favourable consideration to the matter.—*Review of the River Plate.*

A later report, in the *Morning Post*, states that a German wireless station has been established at Buenos Aires, and will begin experimental operations in a short time. Some of the newspapers are urging that steps should be taken to prevent its working.

Wayleaves for Telegraph Wires.—The House of Lords on May 18th, decided that the North British Railway Co. was not entitled to additional payment or compensation from the Postmaster-General in respect of wayleave for telegraph wires erected on the company's railways since 1885. The wayleave was acquired by the Postmaster-General under two agreements of 1868 and 1869, which provided that the Postmaster-General should pay the capital sum of £100,000 and an annual sum of £2,250 in respect of the perpetual wayleave right he had acquired and as compensation for any loss the railway company might otherwise sustain. It was admitted that the Postmaster-General was entitled to free wayleaves for wires which he caused to be erected from 1870 to the end of 1874 inclusive, but it was contended for the railway company that Clause 5 of the supplemental agreement of 1869, by necessary implication, conferred the right to further payments in respect of wayleaves for wires put down after the expiry of the first 15 years. The Lord Chancellor said that Clause 5 did proceed on the assumption that there was some limit to the number of wires which might be erected without payment, but it could not override the general tenor of the two agreements.—*Railway Gazette.*

Western Union.—The report of the Western Union Telegraph Co. for 1916 shows a total income of nearly 62 million dollars, and operating expenses nearly 49 millions. The multiplex system has been extended, and is giving satisfactory results; but for this the increased traffic could not have been adequately dealt with. At the close of the year the company had 1,600,146 miles of wire in use, as well as 2,988 miles of land-line cable and 22,728 nautical miles of submarine cable. The offices numbered 25,234.—*T. and T. Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-H.P. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

MELBOURNE.—July 25th. Victorian Railways. Step-down transformer and sub-station equipment for Sandringham-Black Rock electric tramway. Particulars from the Chief Storekeeper, Railway Offices, Spencer Street, Melbourne.

Dublin.—June 2nd. Coal for the electricity works, &c. Chairman of Supplies Committee, Town Clerk's office, City Hall.

Kingston-on-Thames.—Corporation. One 5-ton steam or electric wagon. Mr. R. H. Clucas, Borough Surveyor.

Newport (Mon.).—June 9th. Tramway Department. Construction of the Newport Light Railway, Section No. 2. See "Official Notices" to-day.

Spain.—June 14th. The authorities in Madrid of the Spanish railway known as the Compania del Norte. Electrification of about 39 miles of line in the Province of Asturias, which gives a connection with the port of Pajares. The line runs through a mountainous district, and comprises 79 tunnels, which represent a distance of nearly 16 miles. The altitude of the railway varies considerably, ranging from 1,150 ft. above sea-level at Pola de Lena to 4,080 ft. at Busdongo. The contract calls for a speed of about 20 miles per hour, and for trains weighing, excluding the electric locomotives, 330 tons.

June 14th. Municipal authorities of Zamora: Concession for the electric lighting of the town during 20 years.

Tenders have recently been invited by the municipal authorities of Viladeriat (Province of Gerona) for the concession for the electric lighting of the town during a period of 10 years.

CLOSED.

Glasgow.—T.C. Accepted tenders. Electricity Department (for 12 months) :—

Electricity meters.—Ferranti, Ltd.; Chamberlain & Hookham, Ltd.
Single cables—Vulc. bit., sheathed, and ins.—Callender's Cable Co., Ltd.
Conc. and triple conc. cables.—Callender's Cable Co., Ltd.
H.T. cables.—W. T. Glover & Co., Ltd.
E.H.T. cables.—Callender's Cable Co., Ltd.
Rub.-cov. cables and flex.—Craigpark Electric Cable Co., Ltd.
C.I. boxes, section pillars, &c. (for six months).—Carron Co.; Falkirk Iron Co., Ltd.; Lion Foundry Co.

Tramways Committee (ordinary) :—

Commutators.—P. R. Jackson & Co.
Chilled-iron and scrap-iron brake blocks.—Carron Co.

High Wycombe.—T.C. Maintenance of electric fire-calls and the water-level indicator: Mr. E. H. Milner, £25.

Johannesburg.—The Municipal Council has accepted the following tenders :—

Telegraph Manufacturing Co.—2,502 ft. ·013 twin cable, £250; 2,001 ft. ·004 twin cable, £150.
Rice, Wilson & Herd.—1,500 ft. ·013 twin cable, £200; 2,500 ft. ·022 twin cable, £375; 1,320 ft. 7/18 concentric cable, £181; 1,320 ft. 7/16 concentric cable, £231.

London.—Metropolitan Water Board. Electric lamps for six months: Pope's Electric Lamp Co., Ltd.

FORTHCOMING EVENTS.

Chief Technical Assistants' Association.—Saturday, June 2nd. At 3 p.m. At the Tavistock Hotel. Discussions (see "Notes" to-day).

Royal Institution of Great Britain.—Saturdays, June 2nd and 9th. At 3 p.m. Lectures V and VI, on "The Electrical Properties of Gases," by Prof. Sir J. J. Thomson, Pres. R.S.

Roentgen Society.—Tuesday, June 5th. At 8.15 p.m. At the Cancer Hospital, Fulham Road, S.W. Discussion on "The Future of the British X-Ray Industry."

Salford Technical and Engineering Association.—Saturday, June 9th. Visit to Messrs. Taylor Bros. & Co., Ltd., Trafford Park.

NOTES

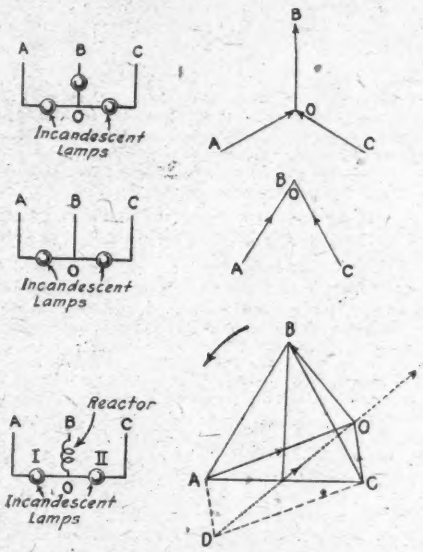
A Marconi Anti-Submarine Device.—Senator Marconi, who is a member of the Italian Commission now visiting Washington, is in communication with the U.S. Navy Department respecting his plan to destroy submarines, which is said to have achieved the destruction of 13 submarines in the Adriatic within a few weeks.

Volunteer Notes.—COUNTY OF LONDON ENGINEER VOLUNTEERS (FIELD COMPANIES).—Headquarters, Balderton Street, Oxford Street, W.

Orders for the Week. By Lieut.-Colonel C. B. Clay, V.D., Commanding :—
Monday, June 4th.—Technical for No. 3, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class. Recruits' Drill, 6.30.
Tuesday, June 5th.—Lecture, 6.30. Physical drill and bayonet fighting, 5.30 to 6.30.
Wednesday, June 6th.—Drill, No. 1, Left Half Company, 6.15.
Thursday, June 7th.—Drill, No. 3 Company, Left Half Company. Ambulance Class by M.O., 6.30. Signalling Class.
Friday, June 8th.—Technical for No. 2 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, at 6.30 to 7.30.
Saturday, June 9th. N.C.O.'s Class, 2.30. Company Commander Hyman and the Instruction of Musketry.
Sunday, June 10th.—Parade Clapham Common Station (Tube Railway), 9.45 a.m., for work at Bombing School. Uniform. Rations to be carried.

MACLEOD YEARSLEY, *Adjutant.*

A Simple Method of Determining Phase Rotation.—By connecting two incandescent lamps and a reactor (or condenser) in star, the phase rotation of any two or three-phase system can be readily determined by observing the relative brilliancies of the lamps. For example, if the lamps and reactor are connected with a three-phase system, as shown herewith, relative dimming of lamp II will indicate that the phase rotation is counter-clockwise, whereas reduction in relative brilliancy of lamp I indicates that the rotation is clockwise. If a condenser is used in



EFFECT OF REACTANCE ON Y VOLTAGES.

place of a reactor, dimming of lamp I will indicate opposite rotation from that shown if the same lamp dims with a reactor in circuit. Where phase rotation has to be determined frequently, as may be the case where considerable reconnection of cable and overhead systems is required, or when numerous motors or transformers must be connected, it may be advisable to mount the lamps and reactors in permanent form.

The action of the indicator can be explained by considering the voltage vector relations. For instance, suppose three equal resistances are connected in star, then the vectors will be equal and will fall 120° apart as shown. If the resistance of one circuit is reduced the vector representing the voltage across the reduced resistance will shorten, allowing the other vectors to lengthen, thereby decreasing the angle between the last mentioned vectors. Under the extreme conditions of no resistance in one leg of the star, the vectors AO and CO will assume the positions shown, which is an open-delta connection. However, if a reactance is inserted in one leg of the star and plain resistance, such as incandescent lamps, connected in the other legs, the intersection of the vectors will not fall on a median. On the other hand, the *locus* will be a circle whose diameter lies along a medium of the triangle A, B, C. Thus the voltage across one lamp will be increased while that across the other is reduced. The portion of the circle which the intersection of the vectors will follow, and consequently the relative briliancy of the lamps, depends on the phase rotation.

To show that dimming of lamp II indicates a counter clockwise phase rotation, and that reduction in brilliancy of lamp I indicates the opposite, consider the lower diagram showing the voltage relation with lamp II dimmer than lamp I. Since the incandescent lamps are non-inductive their currents will be in phase with the potentials across them and proportional thereto. Consequently vectors AO and CO may represent the current relations also. The resultant of these currents will extend in the direction DO, and will be the same as the current through the reactors. OB which represents the potential across the reactor is perpendicular to DO, since it is due principally to reactance. According to fundamental laws, the voltage across a reactor always leads the current, therefore the phase rotation will have to be in the direction indicated by the arrow to satisfy this condition. The converse can be proved in a similar manner, the same reasoning applying to two-phase circuits. —T. W. VARLEY, in the *Electrical World*.

Appointments Vacant.—Chief clerk (47s. 6d.), for the Rhondda U.D.C. electricity department; burgh electrical engineer, for Falkirk; shift engineer, for Reigate Council. See our advertisement pages to-day.

Disabled Soldiers and Sailors.—Admirable work is being done in Newcastle, at the Cowen training school, for the benefit of disabled soldiers and sailors. New electrical workshops have been provided by the trustees, and have been equipped with apparatus for teaching the elements of electric lighting and power, telephone, bell, and signal installation work, the accommodation being adequate for 20 men. A National gas engine of 10 B.H.P. has been installed, driving a Westinghouse 6-KW. dynamo, which is controlled by a Westinghouse switchboard and charges a 60-cell storage battery, which was presented co-operatively by six accumulator manufacturers. The workshop is fitted with benches and tools, large demonstration boards, telephones, arc lamps, instruments, and switchgear, &c., and the course of instruction, which lasts three months, covers interior wiring and the installation of electric light and power apparatus, bells, telephones, &c., as well as the construction and management of the plant, kinematograph projector operation, &c. The training given is as thorough as is possible in the time, and the progress of each man is reviewed every fortnight. The first lot of men began their training on January 12th, and all of them have completed the course and obtained suitable employment.

The trustees have expended more than £250 in equipping the school, and the course is free to disabled soldiers and sailors, some of whom are housed in the Cowen Home. Many electrical manufacturing firms have contributed to the equipment, and the Council of the Institution of Electrical Engineers, through the chairman of the Local Section, has supported the scheme. The electrical section of the Newcastle Chamber of Commerce, and several local firms, including the two electricity supply companies, have also assisted, while a number of local gentlemen have offered to give lectures on subjects in which they are specialists. The supply companies have made arrangements for the men periodically to visit electrical works, power stations, and sub-stations. According to the *Newcastle Daily Chronicle*, the men are keen to learn, and show remarkable aptitude for the work, the results being described as excellent. The Committee would be glad to receive notice of situations which may be vacant, the men being fitted for such work as the care and operation of country house and factory lighting plants, wiring for electric light and power, switchboard operations in power stations and sub-stations, wiring for bells and telephones, including mine signalling apparatus, dynamo and motor attendance, and kinematograph operation.

Communications may be addressed to Mr. W. D. Hunter, managing director and engineer to the Newcastle and District Electric Lighting Co., Ltd., 38, Granger Street West, Newcastle-on-Tyne. The cause is one which must commend itself to our readers; we cannot do too much for our disabled heroes, who have risked their lives and made great sacrifices for the safety of their country.

Wages of L.C.C. Employes.—The Traffic Conciliation Board of the L.C.C. has considered the application of the employés of the traffic section of the tramways department for an increase in wages of 1s. 8d. per day, or 10s. a week, and payment for overtime at the rate of time and a-half, and has decided that the war bonus of employés in the traffic section is to be increased to 1s. 6d. per day for each day worked in the case of male employés. Women conductors are to receive the present bonus of 6d. a day on appointment, an additional bonus of 3d. a day after three months' continuous service, a further bonus of 4½d. after nine months' continuous service, and the full bonus of 1s. 6d. a day after 12 months' continuous service. The arrangement of June 26th, 1914, under which motormen and conductors are paid at the rate of time and a-quarter for overtime, is to be extended to all persons employed in the traffic section. The advances are to commence on Thursday, May 24th.

The Electrical Conciliation Board has decided that fitters, turners, fitters' labourers, blacksmiths, hammermen, machine drillers, crane drivers, wiremen's mates, wiremen, and electricians employed at the Greenwich generating station are to receive war wages of 12s. a week, all other male employés at Greenwich generating station are to receive war bonuses as follows in place of the present war bonus:—Men in receipt of 40s. a week or under, 10s. a week; over 40s. and not more than 50s., 6s. a week; over 50s., 5s. a week. Leading cable hands, cable hands, switchboard attendants, greasers, and cleaners at sub-stations, electrical attendant at Belvedere Road, wiremen's mates of the depôt wiring staff, and the night telephone operators at Camberwell and Shoreditch exchanges are to receive an additional war bonus of 4s. a week. Consideration of the application of the remainder of the telephone operators at Camberwell exchange is adjourned. The rate of pay of the wiremen of the depôt wiring staff is to be increased to 1s. 1d. per hour, the rate paid in excess of 10½d. an hour to be regarded as war wages. The advances are to be payable from May 3rd.

Electric Vehicle Manufacturing Licences.—According to the *Commercial Motor*, Mr. Annan Bryce asked the Minister of Munitions, in the House Commons on March 17th, whether he was aware that an active demand exists for electrically-propelled industrial vehicles deriving motor force from existing power stations using home-produced fuel, whereby the need for the import of fuel and fodder is diminished; whether the Edison Accumulator Co., having taken works for the manufacture of such vehicles in this country, was licenced to produce only a very small number; whether it has been refused certificates to obtain the material necessary to complete even the licenced number; and whether he will now grant priority certificates for such material? Mr. Kellaway, in reply, said he was aware of the demand for vehicles of this character, and it was in view of that demand that the Edison Accumulator Co. were given a licence to manufacture a limited number of chassis in this country. No promise was, or could be, given that all materials required for such manufacture would be forthcoming, but the necessary priority certificates would be issued in respect of any vehicles ordered from the company in connection with work of national importance.

Labour Troubles and Problems.—Mr. Lloyd George, in his speech in the House of Commons last Friday, referred to the industrial unrest of which there have lately been serious evidences in different parts of the country. He said that the termination of the engineering strike afforded a very good opportunity for reviewing the whole of the labour position. Though the particular dispute which occasioned that strike had been happily terminated, there was a good deal of matter for further investigation. He continued:—"There has been great unrest in some quarters. The Government have their views as to how that has been fostered, but, at the same time, there are some genuine grievances which have assisted the designs of those who have ulterior motives which have no special reference to the labour situation. Therefore the Government have decided to appoint commissions to inquire into the industrial unrest, and report on the operation of all war emergency legislation of the Government, and its administration in regard to labour, and to make recommendations which will tend to minimise the industrial unrest, especially in the shipbuilding and engineering trades, during the continuance of the war. It is proposed to divide the country into something like seven areas, and appoint a separate commission to investigate the causes of the unrest in each area. An effort will be made to secure the services of Labour representatives and of employers, with an impartial chairman in each case."

In our opinion, the Premier has been well advised to take this matter in hand now. To have allowed things to drift along of their own accord would have been suicidal. The institution of a thorough inquiry on lines which will promote confidence among the vast bulk of the working population who are out and out loyalists, and which will bring out the exact causes of real grievances and of mischievous dissension, may prevent not only a recurrence of recent troubles, but something worse. The inquiry is a war measure—necessary in order to help us win the war at an early date, and all right-minded people will hope for a speedy arrival at definite conclusions.

It is not to be supposed, however, that such an inquiry can deal with all the questions that Labour and Capital have in their minds as requiring settlement for after the war. The Reconstruction Committee of the Cabinet may have much to do with that larger matter. But the present investigation may do much to clear the air, and may go some considerable distance towards promoting the right atmosphere in which to deal with those other matters.

In the foregoing connection we have received from the Rotary Club of London full copies of speeches delivered by Mr. John Hodge, the Minister of Labour, and Sir Robert Hadfield, F.R.S., at a meeting of the Club in March. They deal in a very useful and informative manner with the question of the alliance of Capital and Labour, and are well worthy of a wide circulation and most attentive reading by both employers and employed. The speeches are published together in pamphlet form (2d.), and are to be obtained in quantity from the Reliable Advertising and Addressing Agency, Ltd., Publicity House, Bucknall Street, London, W.C. 2.

In the Parliamentary questions on May 24th, Mr. Kellaway (according to the *Times*) said that the recent labour troubles were attributed by the strike leaders to the abolition by the Government of the trade card scheme of exemption from military service, and to the clause of the Munitions of War Amendment Bill, dealing with dilution of labour on private work. The restraints imposed on labour by the Munitions of War Acts were, to some extent, contributing factors. The whole problem had been receiving the most serious consideration of his right hon. friend, who would be glad to consider any suggestions for securing a just settlement of these difficulties. In April the Minister of Munitions asked the Advisory Committee representing certain employers' organisations, including the Federation of British industries, to consider the question of industrial unrest, and their report was sent to him on May 21st. His right hon. friend also proposed to consult the Advisory Committee on the subject of the Munitions of War Bill.

Educational.—UNIVERSITY OF LONDON.—We have received a pamphlet describing the aims and work of the Appointments Board of the University, which was constituted by the Senate to assist graduates and students to secure appointments. A register of candidates is kept, and business employers desiring to get in touch with well-educated young men and women are invited to communicate with the Secretary of the Board, at the University, South Kensington, London, S.W. 7.

Zinc as a Substitute for Copper.—According to a series of diagrams published in the *E.T.Z.*, the use of zinc wires instead of copper in transmission lines involves an increased cost of about 30 per cent. for the same pressure drop, or about 70 to 80 per cent. for the same efficiency.

Detinning in Australia.—It is proposed to establish works in Sydney for the purpose of treating scrap tinplate, which has hitherto been shipped to Germany. It is estimated that over 300 tons of tinplate are thrown away annually in Sydney alone. An electrolytic process is to be used.

Institution and Lecture Notes.—Institution of Electrical Engineers (Dublin Local Section).—At the general meeting held at the Royal College of Science, Dublin, on 24th inst., the following were elected as officers and Committee for the 1917-18 session :—

Chairman : Capt. O. T. O'Kelly Webber, R.E.
Vice-Chairman : Mr. J. P. Tierney.
Committee : Messrs. Thos. Tomlinson, C. W. Kirwan, R. Tenham, G. M. Harriss, A. E. Porte, Wm. Tatlow, R. N. Eaton, A. G. Brunty, and W. Storey.

The resignation of the hon. secretary, Mr. G. Marshall Harriss, was accepted with regret, and Mr. R. N. Eaton, of 12, College Green, Dublin, was appointed as his successor. A paper, "Notes on the 1916 Edition of I.E.E. Wiring Rules," by Mr. A. G. Brunty, was read and discussed.

Chief Technical Assistants' Association.—To-morrow afternoon (June 2nd), at 3 o'clock, at the Tavistock Hotel, this Association will resume the adjourned discussion on "Problems of Transmission and Distribution." There will also be a discussion on "Questions of Labour Arising out of the War."

Institution of Mining and Metallurgy.—On May 24th a paper by Mr. W. R. Ingalls on the question "Shall Great Britain and America Adopt the Metric System?" was discussed. Mr. Sulman opened the discussion, supporting the author in vigorous opposition to the compulsory adoption of the metric system, and Mr. Harry Allcock followed, ably advocating an affirmative reply to the author's question. The remaining speakers were fairly evenly divided in opinion pro and contra.

South African Institute of Electrical Engineers.—On April 19th, Mr. A. Ballard read a paper entitled "Notes on Three-phase and Ward-Leonard Winding Equipments."

Diesel Engine Users' Association.—We have received a brochure containing particulars of the constitution of the Association and the privileges of membership, notes on the proceedings during 1916, and a complete list of members, with particulars of the plant in their charge, up to March 31st, 1917. The number of members at that date was 83, and the total H.P. of plant represented was 50,318.

Strike.—The members of the Liverpool branches of the Electrical Trades Union, after being on strike for a fortnight, returned to work on Friday. Dr. Addison, the Minister of Munitions, agreed to receive a deputation to consider the matters in dispute, relating to dilution of labour and other points.

Inquiries.—A correspondent asks for the name of the maker of "Crenoid" insulating material. Makers of the "Telephos" electric gas lighter are asked for. A correspondent wants small quantities of vacuum-treated magnetic iron.

Prohibited Exports.—The Supplement to the *Board of Trade Journal* of May 31st contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Denmark, France (including Algeria), Italy, Japan, and the Netherlands. The Supplement also contains the list of articles (complete to date) which are prohibited to be exported from the United Kingdom.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Bexley U.D.C. has increased the salary of the electrical engineer and tramways manager, Mr. H. P. STOKES, by £100 per annum as from January last.

The salary of Mr. F. T. WRIGHT, charge engineer, Southwark electricity works, has been increased, as from April 1st last, and for six months after the termination of the war, from £3 to £3 5s. per week, rising to £3 10s. per week.

Mr. W. F. BLADON, who has been manager of Barrow-in-Furness tramways, on behalf of the B.E.T. Co., for the last 20 years, has given up that position to take up another appointment under the same company. Last Friday evening he was presented with a gold watch by the employés at Barrow. A satchel was presented to Mrs. Bladon. Mr. DOBSON, who has been assistant manager at Barrow since October last, is Mr. Bladon's successor.

General.—According to the *Times*, LORD MOULTON, Director-General of Explosives Supply, has been nominated for election as president of the Institution of Gas Engineers for the coming year.

Mr. HERBERT M. CURTIS, of Blackburn, who prior to joining the Army was the contract official at Blackburn Telephone Office, is among the *Transylvania's* survivors.

Mr. B. H. COLLINS, well known in the American advertising agency field, has joined the publicity staff of the Society for Electrical Development, in place of HILL GRIFFITH, First Lieutenant, Cavalry, Officers' Reserve Corps, who has been called into active service.

Roll of Honour.—Captain C. R. MCGOWAN, H.A.C., son of Dr. McGowan, Maghara, Co. Londonderry, reported severely wounded in France, was, before going on service, an electrical engineer in the employment of the Post Office.

Captain J. PARKINSON, R.E., who was "mentioned" in Sir Douglas Haig's last dispatch, is an electrical engineer, and an Associate Member of the Institution of Civil Engineers.

Private C. H. GARRETT, West Yorks. Regiment, reported wounded, was on the office staff of the Bradford electricity department.

Sergeant LESLIE BRAND, R.F.A., who has died of wounds received in action, was employed in the engineering department of the Leeds Corporation tramway depôt.

Lieutenant N. SIZER, who is mentioned in Sir Douglas Haig's dispatch, was when war broke out engaged as an electrical engineer with the Westinghouse Co., Manchester.

Sapper T. TURNER, R.E., who has been decorated with a Serbian Order, was before enlisting an employé of the Anglo-American Telegraph Co.

Sapper L. WYLD, R.E., killed in action, aged 19 years, was employed by the Rawtenstall Corporation as an electrical mechanic.

Gunner J. M'ILWRAITH, R.G.A., killed, was with Messrs. Baxendale, Manchester.

Mr. J. C. CURL, of Rochdale, aged 28, was lost in a disaster to the boat on which he was wireless operator.

Private J. E. STALEY, Manchester Regiment, previously reported missing, now reported killed, was with Messrs. Baxendale & Co., Ltd., Manchester.

Lance-Corporal R. SCHOFIELD, of the Newcastle tramways department, has been dangerously wounded.

Lieutenant TOM HAMILTON, West Yorkshire Regiment, who has been reported missing since May 12th, is the fourth son of Mr. J. B. Hamilton, general manager of the Leeds tramways department. Mr. Hamilton has five sons serving in the Army.

The death from wounds of Lance-Corporal J. HOLMES, A. and S. Highlanders, aged 20 years, is reported. He was employed with the General Electric Co., Glasgow.

Mr. KENNETH SMITH, who was a student apprentice at the Rugby works of the B.T.H. Co., has died on active service in France.

Pioneer W. STEWART, R.E., who was with the Rio Light and Power Co. at Rio de Janeiro when he came to England in November, 1915, to enlist, has died in France of wounds received in action.

Lance-Corporal W. SMITHSON, Manchester Regiment, formerly an electrician with Messrs. W. Brierley & Son, of Radcliffe, is reported missing.

Second-Lieutenant C. W. BUTTERFIELD, North Staffs. Regiment, reported missing and believed killed, was employed at the works of Messrs. Siemens, Stafford.

Second-Lieutenant H. LEWIS, A.S.C. (Mechanical Transport), believed to have been drowned at sea, was formerly in the electrical department of Messrs. Harding Bros., of Hereford.

Corporal RICHARDS, of the Torquay Corporation electricity works staff, has been wounded in action.

Mr. HAROLD CAMP, who has died from wounds received in action, was for over 14 years the outdoor representative of the Leyton U.D.C. electric light department. He was 40 years of age.

Gunner G. GRAINGER, R.F.A., formerly of the India-Rubber Co., Silvertown, has been killed in action in France. Private W. T. BONSER, Essex Regiment, also a former Silvertown employé, is a prisoner of war in Germany, and Private H. EDGECOMBE, Argyle and Sutherland Highlanders, formerly of the same company, has been wounded in France. Rifleman E. S. SMITH, Rifle Brigade, was recently wounded in France. All the above were in the general office at the Silvertown Works.

Second-Lieutenant V. C. RUSSELL, Suffolk Regiment, younger son of Mr. Stuart A. Russell, works manager to the India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd., Silvertown, has been wounded a second time, and is now in hospital in this country. Second-Lieutenant Russell has been twice mentioned in dispatches.

Private A. J. CHEETHAM, London Regiment, son of Mr. A. Cheetham, manager of the tire department of the India-Rubber Co., Silvertown, was dangerously wounded on May 15th. Private Cheetham has previously been wounded, on November 29th, 1916. He was formerly in the aero tube department of the India-Rubber Co.

Corporal E. H. TROWBRIDGE, London Regiment, formerly in the electric light department of the India-Rubber Co., Silvertown, was severely wounded in France on May 16th. Private H. A. BARR, London Scottish, formerly in the buying department, has been wounded a second time. Private J. BRENNAN, Duke of Cornwall's Light Infantry, formerly in the general office of the company, was recently wounded in France.

Obituary.—MR. R. W. GAUNTLETT.—We regret to record the death of Mr. Reginald Wilson Gauntlett, late London office manager for Messrs. Bruce Peebles & Co., Ltd., of Edinburgh, which took place on Monday, May 28th, at his residence, 31, Clifton Hill, St. John's Wood, N.W. Mr. Gauntlett's large circle of friends will learn of his death with regret, and will extend their sympathy to his widow and children. Messrs. Bruce Peebles have lost a valued servant, who during his lifetime earned the esteem and respect of all who came in contact with him.

MR. H. CRUSE.—Mr. H. Cruse, who had for a long period been in business as an electrician at Lewes (Sussex), has died at the age of 60 years.

MR. H. F. PARSHALL.—The many friends of Mr. Horace Field Parshall, of Penbury Grove, Penn, Bucks., will desire to join with us in an expression of sympathy with him on the death of his wife, which occurred on May 23rd after a long illness.

CAPTAIN JOHN CHAMBERLAIN.—We have received the following personal tribute to the late Captain Chamberlain from Mr. G. Hookham:—

"Captain John Chamberlain was the son of the late Mr. Arthur Chamberlain, and nephew of Joseph Chamberlain; his elder and only brother, Arthur, is chairman of Kynochs. John Chamberlain was at school at Rugby, and afterwards spent some months in France mastering the language. In matters of commerce and factory organisation he had the inestimable advantage of being trained under his father, who had little short of genius for such affairs. In process of time he took the management of three important companies, viz., Tubes, Ltd., Smith's Stampings, Ltd., and Chamberlain and Hookham, Ltd. In every case he vastly improved the position of these undertakings, turning those that had been less successful into striking successes, and in the case of the last mentioned more than doubling the profits. I can only speak of his loss to this firm as irreparable. Of the personal loss I can hardly trust myself to speak at all—we were all so fond of him. Of an affectionate nature himself, he everywhere attracted affection. In the office and factory he was simply worshipped. In saying this, I am conscious of using a hackneyed expression, and one that is often used in exaggeration, but it is no exaggeration here. Being engaged in such important affairs at home, and with a wife and young family, his friends, with one voice, advised him that it was no duty of his to join the Army, at any rate, at that time. His own conscience, however, advised him differently, and there was no more to be said. He volunteered in the first few weeks of the war. He was severely wounded, and on recovery returned to the Front. He was at last struck down and instantly killed by a stray shell at Brigade Headquarters. Not the least among his attractive qualities was his ever-ready humour. Just before his first departure for France it took the form of saying to me, 'And, you know, the worst of it is I'm such a coward'—which, of course, merely meant that his imaginative brain always insisted on his realising and appreciating the dangers. There are two kinds of courage: one of the man whose spirit carries him forward regardless of all but unconscious of danger, the other of the man who is fully conscious and continually aware of the risks, and yet unflinchingly does his duty. There cannot, I think, be much doubt as to which is the higher form."

NEW COMPANIES REGISTERED.

Southport Electric Supply Co., Ltd. (147,492).—Private company. Registered May 17th. Capital, £1,000 in £1 shares. Objects, as title. The subscribers (each with one share) are: T. Lawyer, 1, Kirklees Road, Birkdale, buyer; S. Stroud, 40, Dinorwic Road, Birkdale, solicitor; E. Stafford, 10, Marshside Road, Churchtown, sales manager. The first directors are: T. Lawyer, S. Stroud, E. Stafford, and J. Bennett. Registered office: 99b, Eastbank Street, Southport.

Apex Electric Accumulator Syndicate, Ltd. (147,516).—Private company. Registered May 21st, by Geo. C. Bingham, 62, New Broad Street, E.C. Capital, £25,000 in £1 shares (10,000 pref.). Electrical and mechanical engineers, manufacturers of electric accumulators and other appliances, &c. The subscribers (each with one pref. share) are: G. Thomson, 65, London Wall, E.C.2, chartered accountant; H. Thomson McCouville, 36, Conway Road, Southgate, N.14. The first directors are to be appointed by the subscribers. Registered office: 65, London Wall, E.C.2.

Electric Holdings, Ltd. (147,558).—Private company. Registered May 24th by Waterlow Bros. & Layton, Birchin Lane, E.C. Capital, £300,000 in £1 shares (200,000 6 per cent. cum pref.). To subscribe for, purchase, or otherwise acquire all or any of the debenture stock and pref. and ord. shares of the British Westinghouse Electric & Manufacturing Co., Ltd., and in particular to purchase all such debenture stock and shares now held by the Westinghouse Electric & Manufacturing Co., incorporated in Pennsylvania, U.S.A., and its nominees, and to enter into agreements (1) with the said American company, (2) with the said British company and the Metropolitan Carriage, Wagon & Finance Co., Ltd., (3) with the said American and British companies, and (4) with the said American company, the Westinghouse Machine Co., the Westinghouse Electric Export Co., and the said British company. The subscribers (each with one share) are: R. A. Pinsent, 6, Bennetts Hill, Birmingham, solicitor; G. J. Withington, 29, Bowyer Road, Saltley, Birmingham, solicitor's clerk. The first directors are: L. D. Docker, E. V. Hiley, and H. Walker. No share qualification required. Remuneration as fixed by the company. Solicitors: Pinsent & Co., 6, Bennetts Hill, Birmingham.

Sheppey Motor Transport Co., Ltd. (147,552).—Private company. Registered May 23rd. Capital, £20,000 in £1 shares. To take over the business carried on in the Isle of Sheppey by the Sheerness and District Electric Power & Traction Co., Ltd., and T. Standen & Sons, and to carry on the business of pier, motor-car, steam and motor boat, omnibus, wagon, and cab proprietors, garage keepers, carriers by land and sea, &c. The subscribers (each with one share) are: G. J. Somerville, Electrical Federation Offices, Kingsway, W.C.2, electrical engineer; T. Bower, 1, Kingsway, W.C.2, company secretary; T. H. Underhill, 1, Kingsway, W.C.2, accountant; A. Charlton, Tramway Depôt, Sheerness, electrical engineer; Mrs. E. Standen, 181, Shortlands Road, Sittingbourne; W. A. Standen, 183, Shortlands Road, Sittingbourne, haulage contractor; A. F. Standen, Southdown Road, Sheerness East, motor engineer; F. J. T. Standen, 181, Shortlands Road, Sittingbourne, motor driver. Minimum cash subscription, eight shares. The first directors are: G. J. Somerville (chairman), A. Charlton, W. A. Standen, and A. F. Standen. Registered office: 1, Kingsway, W.C.2.

E. B. Magnetos, Ltd. (147,542).—Private company. Registered May 23rd. Capital, £8,000 in 6,000 pref. shares of £1 each and 8,000 ord. shares of 5s. each. Manufacturers of and dealers in magnetos, dynamos, accumulators, coils, carburettors, speedometers, accessories, engines, motor-cars, aircraft, &c. The subscribers (each with one share) are: E. D. Oppert, 15, St. John's Wood Park, N.W., retired merchant; J. Hope, 9, Frognal, Hampstead, N.W.3, machinery representative. The first directors are to be appointed by the subscribers. Qualification, 100 shares. Registered office: 16, Howick Place, Victoria Street, S.W.

British Lighting & Ignition Co., Ltd. (147,508).—Private company. Registered May 19th by Surtees, Phillpotts & Co., 6, St. Helen's Place, E.C. Capital, £100,000 in £1 shares. Manufacturers of and dealers in motor and other carriages, railway, and tramway rolling stock, vehicles, cycles, and aircraft, and parts and accessories thereof, electricians, electrical and general engineers, suppliers of motive power, traction, light, and heat, &c. The Board of Trade has authorised this company to acquire the undertaking of the Bosch Magneto Co., Ltd., the books and documents of which are liable to inspection under the Trading with the Enemy Act. The subscribers (each with one share) are: R. B. Phillpotts, 6, St. Helen's Place, E.C., solicitor; H. V. Surtees, 6, St. Helen's Place, E.C., solicitor. The first directors are to be appointed by the subscribers. Qualification, £500. Remuneration (except managing director), £250 each per annum, and £500 for the chairman, or, in lieu thereof, 5 per cent. of the net profits, when 5 per cent. is earned on the ord. shares, divided between them. Solicitors: Surtees, Phillpotts & Co., 6, St. Helen's Place, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Direct Spanish Telegraph Co., Ltd. (6,732).—Capital, £95,000 in 13,000 ord. and 6,000 pref. shares of £5 each. Return dated April 11th, 1917. 12,931 ord. and 6,000 pref. shares taken up; £94,655 paid. Mortgages and charges: Nil.

City of London Electric Lighting Co., Ltd. (34,406).—Capital, £1,200,000 in 80,000 ord. and 40,000 pref. shares of £10 each. Return dated April 4th, 1917. 70,595 ord. and 40,000 pref. shares taken up; £1,105,950 paid. Mortgages and charges: £800,000.

County of Durham Electrical Power Distribution Co., Ltd. (61,591).—Capital, £425,000 in £1 shares, 400,000 shares taken up; £400,000 paid. Mortgages and charges: £250,000.

W. J. Furse & Co., Ltd. (121,420).—Capital, £20,000 in £1 shares (9,000 pref. and 11,000 ord.). Return dated April 14th, 1917. 9,000 pref. and 9,835 ord. shares taken up; £6,384 paid; £12,451 considered as paid. Mortgages and charges: £5,000.

City of Oxford Electric Tramways, Ltd. (91,106).—Capital, £150,000 in £1 shares. Return dated March 8th, 1917. 63,000 shares taken up; £1,007 paid; £61,993 considered as paid. Mortgages and charges. £42,800.

CITY NOTES.

Anglo-Argentine Tramways Co., Ltd.

The gross receipts during 1916 were £2,714,226, less working expenses (including £96,000 carried to depreciation renewals reserve, in addition to £257,366 expended on ordinary maintenance) £1,956,668, leaving £757,557, plus £40,008 interest on investments, &c., and £94,120 brought forward, making £891,685. This is dealt with thus:—Annuity to City of Buenos Aires Tramways Co. (1904), Ltd., £70,660; interest and sinking funds on debenture stocks, £587,821; sinking fund for redemption of preference and ordinary shares, £6,236; dividend on 5½ per cent. cum. pref. shares, £176,000; carry forward, £50,969. Traffic receipts increased by £5,588, and passengers by 1,437,360. The abnormally high cost of fuel still continues to prevail, the increased traction charges, notwithstanding economies in consumption, being £161,477. In all departments the strictest economy has been exercised. In view of the foregoing conditions, no dividend can be distributed for 1916 on the 5½ per cent. cum. second pref. shares. The general manager says that it is almost as difficult as last year to forecast traffic prospects for 1917. The great unknown factor, of course, is developments in Europe. Local affairs had shown a very slight improvement in some ways during the past few months, but all classes of crops had been exceptionally poor this year owing to the prolonged drought, and the now abundant rains had come too late in most parts to improve immediate prospects. They might feel the results of this later in the year, and if they maintained their traffic of last year, with perhaps an increase of 1 per cent., it was about as much as they could expect. As regarded net profits, the cost of coal was never a more uncertain factor than now. Excluding the fuel question, they would, he was sure, compare favourably with last year, and expenses would be kept down to a low figure. Annual meeting: June 7th.

Lisbon Electric Tramways, Ltd.

Net profit for 1916, £51,021, plus £8,736 brought forward. There has been put to depreciation reserve £25,000, and the usual 6 per cent. pref. dividend absorbs £25,533, leaving £9,224 to carry forward. In order to make the year's appropriation to depreciation reserve up to the necessary £30,000, £5,000 was transferred from the Exchange reserve for this purpose. Passengers carried 76,620,194, against 67,101,249; earnings Es. 2,324,655 $58, against Es. 2,022,142 $93. The working expenditure increased out of all proportion, and exceeds the figure of the year 1915 by Es. 336,896

$730, owing to prices of coal and other supplies and of labour. The profits are further affected by the lower rate of exchange, the average of which has fallen from 35.97d. to 33.73d. These adverse conditions are more pronounced at the present moment, and there is every probability that they may yet become more severe. Efforts of the company to secure an increase in tariff were opposed by the Municipality and the Government, and they were dropped for the time being, but the matter will be raised again this year. Notwithstanding the increased traffics, the company has sustained a very heavy diminution of profit compared with pre-war years. In 1913, after the payment of debenture and preference interest there was an available balance of £78,153, against £25,488 in the past year—a falling off in profits of £52,665, showing the effect of the war. It was, therefore, essential to secure the company's financial position against all contingencies, and they must forego the usual recommendation of a dividend on the ordinary shares. The board record appreciation of the services of the local board, of Mr. Kolkhorst, the general manager, and of the staff.

Calcutta Electric Supply Corpn., Ltd.

At the annual meeting, held in London on May 23rd, the Chairman said that the generation costs had increased by £1,652, owing to the production of nearly 3,000,000 additional units. Income-tax paid in India increased by £4,330, owing to the Indian rate of tax having been more than doubled. The amount of excess profits duty was difficult to ascertain, but it was covered by the large carry forward. The speaker briefly explained why it was not now so necessary as formerly to put so large a sum to the depreciation and renewals account, and referred again to the agitation by a certain section of the Calcutta public for reduced charges, which he mentioned a year ago. These persons claimed that the several reductions already made were the result of their movement. It would obviously be useless to attempt to undeceive them. The policy of the directors had always been to maintain an equitable attitude both to the consumer and to the shareholder. All reductions hitherto made had been in accordance with the declared policy of the company, which no doubt the majority of the Calcutta public fully recognised. The Government of Bengal had, however, appointed an expert committee to satisfy them as to the reasonableness of the demands for reductions, and that committee last November summed up the situation by stating that the arguments of the critics on the question of excessive charges were "generally misleading and fallacious." Notwithstanding this, the Bengal Government had published a resolution stating that the Governor in Council had carefully considered the question as to whether he should now exercise his statutory powers with a view to secure reduction, and that there was a "strong *prima facie* case for such action on his part." The directors felt that the matter could not have received full consideration, and they had pointed out in the proper quarter the serious difficulties which such a resolution, based on so slender a foundation, brought upon those charged with the administration of the company's affairs. They had still before them the grave necessity for restoring confidence in the minds of English investors in Indian concerns, which this action must go far to disturb. They were not without hope that the incident might be closed in a manner satisfactory to all parties. The whole matter had unfortunately brought them very unwillingly into some antagonism with the Government of Bengal, and it had also postponed a further reduction which they had under consideration to announce from January 1st, and which, had it not been for this ill-informed agitation, would have been given effect to. The delay caused by the Trades' Association Memorial had, however, given them the opportunity to reconsider their position with reference to the increased taxation imposed upon them both in India and in England since the commencement of this year. The Excess Profits Duty for 1917 was to be on an 80 per cent. basis, as compared with 60 per cent. in the past two years. Their profits earned during the war had increased over those of the pre-war period solely because the large outlay of capital provided long before the war was dreamt of, had begun to bear fruit. Their profits were in no sense war profits: indeed, the war had affected them adversely, and the tax fell upon them with a severity which hardly appeared equitable. In respect of 1915 the duty claimed by the revenue authorities at 60 per cent. amounted to £21,661, but in respect of 1916 it would be considerably heavier. In India, too, a super-tax of 25 per cent. had been imposed, regarding which they found it difficult to obtain any accurate information, but which would certainly add to their burdens during the war. They had, however, obtained a concession from the Government, by way of relief in respect to the English taxation, the rate of tax payable being reduced by the rate paid in India. The directors were confronted with several conflicting considerations: a desire to continue their policy of reducing the consumers' costs; of giving the shareholders some reward for the venture they had successfully made; a doubt as to the stability of their position engendered by the Government action; and an uncertainty as to further requisitions that might be made on their resources on account of the war. They had, however, attained a position in other respects which strengthened them financially to a very considerable extent. Owing to the abnormal conditions of the money market they were not writing off anything this year against depreciation of investments. The want of additional plant had the effect of preventing their output from increasing, and their agent had been obliged to announce that they could not entertain proposals for new connections beyond the capacity of the existing plant. The increases of revenue which had been a marked feature of the past few years were not likely, therefore, to continue during the war period, at least, not to the same extent. Considering all the circumstances, however, they had decided that the best course was to continue their policy of reducing charges undeterred and unaffected by the side issues created by the agitation in Calcutta, but at the same time with due regard to the grave issues brought about by the war. They were, therefore, announcing a reduction in the flat rate of one-quarter of an Anna per unit as from July 1st. The cost of this would be between £12,000 and £14,000 per year in a full year of operation. This would very considerably benefit the smaller consumers and those whose consumption of fan units did not greatly exceed their light units; it was subject to the proviso that if the exigencies of the war imposed the necessity they might have to revert to a higher price. They were recommending an increase in the ordinary dividend by one-half per cent., costing £2,750. Instead of the staff bonus on profits they had granted a war bonus of 10 per cent. in salaries for the war and six months after. They had lost three consignments of stores (meters, bitumen, gutters, and covers, &c.) owing to sinking of steamers. New coal contracts had been arranged, one for three years and the other for two years, at slightly increased prices.

Kalgoorlie Electric Power and Lighting Corpn., Ltd.

Mr. E. POPE presided at the annual meeting, on May 24th. He expressed regret that they had been unable to maintain the profit at the level of the previous year. The higher cost of stores and supplies of every kind had been a factor in the reduction of the profit, and another cause had been increased taxation, but the main cause had been shortage of labour, due partly to the large number of men who had joined the Colours, and partly to the action of the dominant Labour Party, who insisted on the internment of all technically enemy aliens. Many of the men were either Poles or Slavs, nominally Austrian subjects, but having no sympathy whatever with the Central Empires. This shortage of labour had interfered with the efficient working of the mines and, by reducing the output of ore, had lessened the demand for electric power. It had also caused a rise in the price of firewood, which they felt more this year than last. The new arrangement made with the trustee of the debenture holders meant that between now and the end of the year they had to find £3,600 for interest and £31,200 for repayment of principal, a total of £34,800. Next year they would require £2,100 for interest and £7,500 for repayment—a total of £9,600. With those payments to make in discharge of debt, they must not consider the directors unduly timid if they hesitated to pay the usual preference dividend next October. They would be delighted to pay it if they could safely do so, but they might have to postpone the payment until after the end of the year repayments to the debenture holders. They could not negotiate a new debenture issue to pay off the old in these days of stress and strain of war, so the money must be provided, if possible, out of profit. He ventured to hope that after the final repayment of the debenture debt there would be annually a sufficient margin of profit remaining, after the payment of the full 6 per cent. on the pref. shares, to reward the long-waiting holders of the ordinary shares with a reasonable dividend. Their stocks in hand and in transit increased, because it was prudent to hold larger stocks of supplies owing to transport difficulties. The financial position as shown by the investments improved considerably during the year. They had sold a stock of copper wire not immediately required, owing to its abnormally high price. They anticipated being able to meet all their end-of-the-year payments without serious difficulty. They had not been doing well during the first four months of 1917, but the result was rather better than for the same period of 1916. The general position of the mines on the Kalgoorlie goldfields was not as good as a year ago. If the war went on until this time next year, as seemed very likely, it would probably then be again worse, as there was still a tendency to a further labour deficiency and increased prices for supplies.

Stratford-on-Avon Electricity Co., Ltd.—Mr. W. H. JACKSON presided at the recent annual meeting. He said that the year had been a progressive one so far as the units sold were concerned, the increase being 8,238, but the lighting units showed a decrease of 13,000, and that had made a considerable difference in the receipts. Power units increased by 13,000, and heating by 8,000. The directors regretted that they could not recommend a dividend as they had had to put money to depreciation, as they did not do so last year. They must be prepared for heavy expenditure in the early future in respect of mains renewal and battery extension, but present prices were prohibitive. It was most unfortunate that the mains were giving so much trouble and anxiety, and he could not help saying that whoever supervised the work on them was responsible for their present condition.

Calcutta Tramways Co., Ltd.—The report for 1916 states that the revenue amounts to £119,681, plus balance brought forward £6,812. With the proposed final dividend, the distribution on the ordinary shares will be 9½ per cent. for the year, leaving £9,595 to carry forward. The reserve for depreciation, &c., at the commencement of the year stood at £81,484; after deducting therefrom £8,643 written off for renewals during the year and adding £20,000 proposed to be allocated thereto, the reserve will stand at £92,841. In addition to this, the directors have opened a separate reserve fund for depreciation of investments, to which they transfer £2,000.

Swansea Improvements & Tramways Co., Ltd.—The report for 1916 states that the revenue amounted to £72,342, an increase of £7,258. After deducting all expenses chargeable to revenue, the surplus was £13,571, plus £2,415 brought forward. The traffic receipts show a considerable increase compared with the previous year, but nearly the whole of the increase has been required to meet increased expenses. A dividend of 6 per cent. on the ordinary shares is to be paid, carrying forward £2,588.

Electro-Bleach & By-Products, Ltd.—The company announces that, although the audit has been completed, the directors are not yet able to present the balance sheet for 1916. The Ministry of Munitions, owing to great pressure of work, have not yet been able to adjust the duties payable by the company in respect of that year.—*Times.*

British Electric Traction Co., Ltd.—The directors have decided to place £15,000 to reserve, and to recommend a dividend of 3 per cent. on the ordinary stock—the same as last year—carrying forward £97,593.—*Financial Times.*

United River Plate Telephone Co., Ltd.—Final dividend, 5 per cent. on the ordinary shares, making, with the interim dividend, 8 per cent. for 1916, free of income-tax, carrying forward £6,990.

Reduction of Capital.—*Creed & Co., Ltd., Croydon.*—A petition has been presented for confirming the reduction of capital from £130,000 to £90,000.

Doulton & Co., Ltd.—After paying the preference dividend, the balance of £43,552 is to be carried forward.

STOCKS AND SHARES.

TUESDAY EVENING.

THE war news of the Bank Holiday week-end produced nothing sufficiently exciting to move Stock Exchange prices on the return of members to their accustomed haunts. Discussion concerns itself with age-raising prospects. If men up to the half-century are to "go," can the Stock Exchange carry-on? Lord Derby declared in the Stock Exchange itself that the House was a necessary part of the national machinery. But were the age-limit advanced to 50, or even to 45, it is questioned whether the Stock Exchange business could continue.

The gorgeous weather helped to stimulate a little demand for Home Railway stocks. Undergrounds are better again, the Income bond being 1½ up at 82. Buyers have come in from provincial centres, and they seem prepared for the next coupon to be 4 per cent., the same as last, although in the market the hope is expressed that 5 per cent., to something more, may be paid. Metropolitan Consolidated is also a good spot, with a rise to 23¼. The efforts of a few mild speculators to snatch an occasional fiver from "Mets." make the motive power for these movements. The Surplus Lands stock has improved to 49. Considerable interest is taken in the suggestion that Capital and Labour should declare a truce for the rest of the war.

Recent events led to inquiry as to the price of Folkestone Electricity shares. Ordinary and 5 per cent. preference are both of the nominal value of £5, fully paid, and the quotations are 3¾-4 in each case. Business was last done at 3¾ in the ordinary, and at 3/16 in the preference; this occurred in February and March respectively. Seven per cent. was paid on the ordinary last year. There is also a 4½ per cent. debenture stock, quoted at 80, as against 94 on the outbreak of war: interest is payable in February and August. The market in the three classes of capital has always been largely local.

Amongst other provincial companies, Bournemouth and Poole ordinary stand at 8½, the 4½ per cent. preference at 7½, and the 6 per cent. second preference at 9¾. Oxfords are 4½ and 4½ for ordinary and preference respectively. Newcastle-on-Tyne ordinary £1 shares are 18s. 9d., and the 5 per cent. preference 17s. 6d. Urban ordinary have stuck for several weeks at 3s. 6d., and the 5 per cent. preference changed hands early in May at 37s. 6d.

The list of London shares is quiet, but prices keep up with noticeable strength. City ordinary shares are difficult to buy under 12; County ordinary remain firm at 10½. Chelseas have been dealt in at 52s. 6d. and 53s. 9d., Charing Cross at 3¾. There is a little going on in Brush ordinary on the basis of 25, but the debenture stocks are hardly mentioned. Metropolitan ordinary are wanted at a trifle over 50s.

The telegraph market is characterised by its usual strength. Anglo-American preferred is ¼ up, Eastern Extensions rose ½, Eastern Telegraph ordinary gained a point, and Great Northerns, at 36½ ex dividend, have recovered part of the amount deducted. Oriental Telephones are firmer, but Marconis are attracting less attention again, although the price keeps very firm at 58s. 9d., Americans being 16s. 6d.

Brazilian Tractions, following their recent erratic course, have lost a point; and British Columbia Electric Railway stocks are still very flat, the 4½ per cent. debenture going back 4 points to 60. The preferred shares are 5 points down at 37½, and the fear of competition is debited as being the reason for the pressure to sell which has caused such heavy declines in the price. The Argentine group is steady, and interest has again died out in Mexican shares and bonds.

British Westinghouse preference gained another 1/16 as the direct result of the recent meeting at which the scheme for reorganising the capital, and for bringing control of the company on this side of the Atlantic, was agreed to. Edison Swan are lower at 10s.; and amongst other low-priced issues, Cordobas have fallen 9d. to 4s. Babcock & Wilcox are up ¼ to 3 1/16, following the trend of iron and steel shares as a whole. Prices in this section have been mounting daily, and armament shares participated in the strength of the market. The rubber group is hard; and the fact that, on pay-day this week, dividends were deducted from shares in the case of 55 different rubber companies, advertised the attraction of rubber share for speculative-investment purposes.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price May 29, 1917.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary	5	5	3¾	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	2½	—	6 18 6
Chelsea	4	3	2¾	—	5 4 4
City of London	8	8	11½	—	6 16 2
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10⅝	+ ⅛	6 11 9
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5½	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	9½	—	5 6 8
Metropolitan	3	3	2½	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall	8	8	6½	—	6 8 0
South London	5	5	3⅞	—	7 5 6
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	6½	+ ½	6 1 9
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	17½	+ ½	6 3 1
do. Def.	33/6	1½	22½	—	6 13 4
Chile Telephone	8	8	6⅛	—	5 15 4
Cuba Sub. Ord.	5	5	8	—	6 5 0
Eastern Extension	8	8	13⅜	+ ⅛	*5 17 6
Eastern Tel. Ord.	8	8	139	+1	*5 15 1
Globe Tel. and T. Ord.	7	7	12½	—	*5 12 0
do. Pref.	6	6	10½	—	5 18 5
Great Northern Tel.	22	21	36½ xd	+ ½	6 0 7
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	2 1/16	—	8 8 0
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord.	10	10	2⅜	+ 1/16	4 11 6
United R. Plate Tel.	8	8	6⅞	—	*6 0 9
West India and Pan.	6d.	6d.	1½	—	2 4 5
Western Telegraph	8	8	14	—	*5 14 4
HOME RAILS.					
Central London, Ord. Assented	4	4	6½	—	6 3 0
Metropolitan	1	1	23½	+ ½	4 6 0
do. District	Nil	Nil	16	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. do. "A"	Nil	Nil	6 6	+6d.	Nil
do. do. Income	6	5	82	+1½	*6 2 0
FOREIGN TRAMS, &c.	Dividend 1914.	Dividend 1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3 1/16	—	8 19 6
do. 2nd Pref.	5½	5½	2⅝	—	—
do. 5 Deb.	5	5	69	—	7 5 0
Brazil Tractions	4	4	47	— 1	Nil
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Ry. Pfce.	5	5	60	—	8 6 8
do. do. Preferred	—	Nil	37½	— 5	Nil
do. do. Deferred	—	Nil	32½	— 2	Nil
do. do. Deb.	4½	4½	65	— 4	7 1 9
Mexico Trams 5 per cent. Bonds	—	Nil	40	—	Nil
do. 6 per cent. Bonds	—	Nil	30	—	Nil
Mexican Light Common	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds	Nil	Nil	87½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	3 1/16	+ ¼	4 18 0
British Aluminium Ord.	5	7	26/9	—	7 7 10
British Insulated Ord.	15	17½	12⅝	—	7 0 0
British Westinghouse Pref.	7½	7½	2 1/16	+ 1/16	6 3 0
Callenders	15	20	12½	—	7 6 10
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	3 1/16	—	6 13 0
Edison & Swan, £8 paid	Nil	—	⅛	— 1/16	Nil
do. do. fully paid	Nil	—	1⅛	—	Nil
do. do. 4 per cent. Deb.	4	4	70½	—	5 13 6
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 3 1
do. Ord.	10	10	15	—	6 13 4
Henley	20	25	15½	—	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	37	—	*6 9 10

* Dividends paid free of income-tax.

STATIC SUB-STATIONS.

[COMMUNICATED.]

Because the static sub-station is a simple and reliable part of a distributing system, it has been at times sadly neglected and its purposes misinterpreted and abused. It is distinguished from the rotary sub-station by reason of the fact that it often gets much less attention than it really requires, whereas in a rotary sub-station it is necessary at all times to have some responsible person in attendance. A visit once a week is as much as many of the most self-respecting static sub-stations usually get, while many are not visited or inspected for weeks on end, for although some distribution systems have specially-appointed sub-station attendants, whose sole duty it is to keep clean and in thorough working order the sub-stations entrusted to their care, on others, the work is delegated to the jointers as a spare-time job, with the result that whereas those most handy receive a fair amount of attention, those more remote are hardly ever inspected.

This latter system is undoubtedly bad, but even where attendants are specially employed, the right sort of man is, in many instances, not secured. The writer has met several who had absolutely no idea of what was happening inside the transformers beyond the fact that, say, 3,000 volts "went in" on one side, and only 200 "came out" on the other. He was once asked by an attendant what happened to the 2,800 volts. Another attendant was surprised to learn that his transformer was immersed in oil.

These may be exceptional cases—the writer hopes that they are; but the fact remains that there are such, and that it is impossible for them to do justice to their jobs or to themselves.

A proper and complete system of records should be adopted for all sub-stations. It is not sufficient to have a register showing the location of them and the number of transformers installed. What is required is a full knowledge of the amount of work each transformer is doing. The central station is well provided with instruments to measure the output and to ensure that machines are not overloaded, while numerous sub-stations are absolutely devoid of instruments, and the mains engineer will measure the output of a sub or a transformer by the rise in temperature. It is true that he has ammeters on his feeders at the central station, but there may be three or four sub-stations to one feeder, and the knowledge thus obtained is therefore not of very great value. The best means of measuring the loads on sub-stations or transformers is by ammeters, preferably recording, on the secondary side. As the majority of sub-stations are visited only during the day-time, readings obtained on ammeters other than of the recording type are apt to be very misleading, for although in some industrial centres the day load may equal, or even exceed, the night load, generally speaking, it is the night load which determines the transformer capacity necessary.

Integrating watt-hour meters are also a real necessity on the L.T. side of transformers, yet they are rarely employed throughout a system.

As in many other matters electrical, there has in the past been very little standardisation in sub-station practice. Not only is this noticeable in the construction of different sub-stations, but even the number of sub-stations required for the best distribution appears to be a very arbitrary matter. Of course, this must necessarily depend, to a very large extent, on the area covered by the supply and the special requirements of the district, but the lay-out of a system must not be determined solely on these two points. Other matters, such as capital cost and running expenses, are quite as important, but in exactly the same way as it is wrong to be guided entirely by the first two points, so is it an error of judgment to pay too much attention to the latter. A happy medium must be struck, so that the supply may be made as perfect as possible, but, at the same time, as cheaply as possible.

In comparing various systems that the writer has come into contact with, he has been struck by the differences in the numbers of sub-stations employed. For the purpose of this article, it is proposed to compare two. The areas covered and the number of units supplied are practically the same, although one district is slightly more industrial, while the other is more residential. There is consequently a margin of difference in the numbers of consumers and in the load factors of the two supplies, and there is a very great difference in the number of sub-stations in the two cases, for the former, with less consumers, uses more than three times the number of sub-stations employed by the latter.

This is largely accounted for by the fact that in numerous instances in the industrial district, sub-stations have been erected on the factory premises, and serve that factory alone. Now, it is thoroughly expedient, where possible, to persuade the consumer to build the sub-station at his expense, or to set apart some portion of his buildings for this purpose, but the thing can be pushed too far. From the point of view of capital cost, it may, under such conditions, pay to make a new sub-station; but when it comes to the question of running costs, a different tale is to be told. A glance at the following figures will show the relative costs of running two sub-stations, the first being used for a group of consumers, and the second for one consumer only. While the writer does not claim that these figures have been actually obtained by measurement, he knows of cases where the conditions assumed are generally satisfied.

In the first case, he has taken a 50-KW. transformer on a load factor of 25 per cent.—a very fair figure; while in the second case, a 30-KW. transformer is installed on private premises, and supplies a demand of 10 KW. for 10 hours a day, remaining practically idle for the rest of the 24 hours.

The magnetising loss in the first case would be, roughly, 6,000 units per annum, and the output about 100,000 units per annum. In the second case, the magnetising loss would be about 5,000 units and the output about 35,000 units per annum. Copper losses have not been taken into account, because they are dependent upon the load taken, and would not be largely affected by the number of transformers used.

The figures show that the percentage of magnetising units compared with the output is, in the first case, 6, and in the second instance 14. Now the difference between the two outputs, 65,000 units per annum, would require two other transformers under the same conditions as taken in the second case, which would mean another 10,000 units a year wasted in magnetising current.

It is clear, therefore, that the system which employs an excessive number of sub-stations is not efficient, because of the huge magnetising losses. Yet the writer knows of a system that boasts 70 sub-stations for an annual output of less than 5,000,000 units. Taking an average of two transformers per sub-station, this would mean an annual magnetising loss of about 750,000 units, or about one-seventh of the output. To this must be added the copper losses of the system, so that, roughly, one million units are wasted annually, or a fifth of the whole output.

For an output of 5,000,000 units a year, about 30 sub-stations should be ample, and, in the second case quoted above, an even less number was used, and the units "unaccounted for" were in the region of 400,000.

The saving is apparent, for even at generating cost these lost units mean a considerable cash value. There is, again, a great difference in the management and lay-out of these two systems. The 70 sub-stations are left to the uncertain care of the jointers, and the writer has seen some of them in a far from pleasing condition. So little attention has been given some of them that a considerable depth of water has been known to accumulate over the floor of one of them at least. In another instance, one of the H.T. fuses was not making contact, having been shaken loose by vibration, perhaps some weeks before it was discovered. The load on this sub-station was, therefore, thrown on to others linked with it, and the margin of "safety" was so great that no indication was given that this fuse was loose.

On the other hand, the system with the smaller number of sub-stations employs two men permanently to look after the transformers, switchgear, fuses, &c.

There is, however, a point in favour of this latter system which has been, on certain occasions, of as much importance as the regular periodic inspection of the sub-stations. There is probably no central station of importance in this

country that has no peak load during the evening, and it is perhaps during these hours that the majority of calls for assistance from the consumers are received. This is to be expected, for it is during the evening that the greatest number of consumers are using current.

In most places, there is a distinct centre to the town, where are concentrated all the most important shops. It is particularly advisable to have someone very handy to these shops in case of emergency, because a failure of supply during their busy hours may mean a great deal to them. The central station is rarely erected in the centre of the town, and if in case of a breakdown, either in a single shop or in a whole street, a man has to be dispatched from the works, or a jointer called out from his home, an annoying delay is the inevitable result.

It is much wiser to keep a man on the spot, and this special emergency man can well be one of the sub-station attendants. This system is actually adopted in the second of the cases we are comparing, and it is certain that much satisfaction has been given to unfortunate consumers by the prompt attention and assistance they have received when in difficulties.

All the gain, however, is not with the consumer, because the engineer responsible for the lay-out of the system was wise enough to realise beforehand the needs of the central portion of his town. The quantity of electricity used in the shopping centre of a town during the day is very small compared with the quantity consumed during the evening. It is, therefore, good practice to take out several transformers during the day time, and use them only as the load comes on.

A large sub-station in telephonic communication with the works has therefore been erected in the middle of the shopping area, and it is here that the attendant on emergency shift waits for a call. In addition, however, he has to watch his ammeters, make a record of the load at regular intervals, and switch in other transformers as they are required, and take them out again as the load goes off.

This effects a considerable saving in magnetising units, and quite probably the wages of the two attendants are entirely paid by this one economy. The same thing can, of course, be done automatically, but, on the whole, the writer is of the opinion that the man on the spot is of more value than an automatic relay.

The town with 70 sub-stations has no large sub-station in the centre of the town which is regulated either by an attendant or automatically, neither does a man stand-by at night in case of breakdown. Compared with the second town, therefore, it is at a serious disadvantage. The present is a time when the minimum of labour should be employed, but the remarks in this article refer generally to pre-war days, and will apply equally to the good time which is to come after the war.

There are several other points which the writer had hoped to discuss, but these, chiefly on the design and equipment of static sub-stations, must be reserved till another time.

It goes without saying that all sub-stations on a system should be interlinked, as then no serious interruption of supply takes place, even if a transformer or a sub-station is temporarily out of use.

It may yet happen that some standard may be set in sub-station practice not only as regards numbers and management, but also in construction, so that an engineer can ring up a firm, and within a very short time have the whole equipment in one of his sub-stations changed for new by the simple process of taking off a few nuts and fixing up the new standard switchgear, &c., just as he would fit new brushes to a motor.

U.S. Farm Electrification.—The Washington Water Power Co., of Spokane, Washington, has closed a contract with the owner of a 10,000-acre farm west of Sprague, Washington, to install complete electric equipment for all purposes on the farm. This will include three 15-H.P. motors to run the pumps for the irrigation project, a 10-H.P. motor for the chop mill, a smaller motor for a wood saw, and a portable motor for general purposes. All of the farmhouses, bunkhouses, barns, feeding sheds and feed cellars are to be electrically lighted. The equipment will be the largest and most complete on any farm in the Northwest.

THE FARADAY SOCIETY.

GENERAL DISCUSSION ON "OSMOTIC PRESSURE."

As an interesting change from the consideration of subjects of direct technical interest, the Faraday Society, at their May meeting, discussed some of the fascinating problems connected with the far-reaching subject of solution. On this occasion, the president, SIR ROBERT HADFIELD, F.R.S., having contented himself by suggesting that "there's nothing like steel," and that even osmotic pressure might justify its existence if it succeeded in explaining the wonderful properties of carbon in iron, invited SIR OLIVER LODGE, F.R.S., a distinguished exponent of this branch of chemical physics, to preside over the discussion. The choice was a happy one, for Sir Oliver has a wonderful gift for seeing rock-bottom where physical phenomena are concerned, and his penetrating comments and lucid interpretations were by no means the least interesting features of a very enjoyable and illuminating discussion.

Those whose physical chemistry is rusty, may be reminded that osmotic pressure is the pressure—real or supposed, and perhaps even negative—exercised by a substance in solution, say when sugar is dissolved in water. This pressure, or quasi-pressure, cannot be observed quite directly, but its effect is made most obviously visible by separating a solution from the pure solvent by a semi-permeable membrane, which, to keep to one illustration, will allow the water to pass through, but not the sugar. One can prevent the water from passing into the sugar through the membrane by exerting a back-pressure in the solution.

Prof. ALFRED W. PORTER, F.R.S., who opened the debate, defined osmotic pressure as the equilibrium difference of pressure between a solution and the pure solvent when separated by a membrane permeable to the solvent alone. That is the direct method of defining and measuring osmotic pressure, and it has been experimentally utilised in America by Morse and others, and in England by the Earl of Berkeley, F.R.S., who took part in the discussion. Osmotic pressure can also be measured indirectly, since it can be shown by means of thermodynamic reasoning to be connected with the lowering of the vapour pressure of a liquid when a solid substance is dissolved in it. The fundamental fact about osmotic pressure, however measured, is that in dilute solutions it exactly obeys the ordinary gas law, $pv = RT$. This strange fact led van't Hoff, many years ago, to put forward the famous theory of solution which would make the process purely physical, or anyhow kinetic. The osmotic pressure is caused by the solute in its effect to diffuse and expand, just as a gas expands and fills a room, and it is completely analogous in origin to the pressure of a gas in a closed vessel.

Just as the gas law needs modification for gases under high pressure or low temperature, so does the osmotic pressure relationship; but this fact, maintains Prof. Porter, no more militates against the truth of the kinetic theory, than it does in the corresponding case of gas. He has suggested a modified formula, $p(v - b) = RT$, to fit the whole range of measurements, where b is a function (not quite constant) of the volume of sugar present, and from the variations in which the degree of hydration of the sugar can be calculated. Investigation of the Brownian movements (the strange, erratic motions of colloidal particles in suspension made visible in the ultra-microscope) prove that translatory molecular movements do actually occur in a liquid, and Prof. Porter maintains that the *causa causans* of the whole phenomenon of osmotic pressure is the molecular bombardment of the solute. A knowledge of this indicates the only way in which the value of the pressure has been calculated from any direct theory of the mechanics of the solution. The dissolved substance is everything that matters, as Sir Oliver neatly put it.

The next speaker, DR. F. TINKER, of the University of Birmingham, maintained, on the other hand, that the membrane is everything that matters, that the phenomenon has no meaning apart from what happens at the membrane, and that it is in the selective action of this where one is to look for the physical explanation desired. On this view, even the allied phenomenon of lowering of vapour pressure in a solution is one which takes place at a semi-permeable membrane, for such is the free surface of a solution which allows the solvent to pass across it, but not the non-volatile solute. Similar in character to, but not identical with this, is the process of osmotic diffusion, according to Dr. Tinker's conception, and osmotic flow takes place because the pure solvent induces a greater pressure of concentration of moisture inside the membrane than the solution does. Why this should be the case is not at present clear, and various causes for it have been suggested, such as selective absorption on the part of the colloidal membrane, or surface tension, or selective chemical affinity and the formation of loose chemical combinations, or catalysis. The cynic may be forgiven if he regards many of these explanations as allotropic forms of "ignoramus."

Neither of the above theories satisfied MR. W. R. BOUSFIELD, K.C., F.R.S., who put forward the claims of yet another theory of osmtic pressure. The former was unsatisfactory, because it left out of account the activity of the solvent; the second, because what took place at the membrane was really irrelevant, and not essential to osmotic phenomena. Mr. Bousfield takes into account the molecular constitution of water, which, according to the now generally-accepted opinion, is a ternary mixture of monohydrol or steam molecules (H_2O), dihydrol molecules $(H_2O)_2$, and trihydrol or ice molecules $(H_2O)_3$. The relative amounts of the three constituents depend on the temperature; near the freezing point there are many ice and few steam, near boiling point there are

many steam and few ice molecules. Mr. Bousfield showed that the osmotic relationships can be deduced on the hypothesis that the steam molecules behave as a perfect gas in the interstices of the solution—a not entirely acceptable assumption. Not in the expansive force of the solute molecules, but in the active energy of the steam molecules is to be sought the origin of osmotic pressure, and these are to be visualised as darting into the regions of less vapour pressure and pushing aside the more inert solute molecules, whose function is thus not to increase the activity of the solution, but to decrease it by destroying some of the steam molecules on which vapour pressure depends.

A somewhat similar theory, but based on the known association between solute and solvent, was put forward in the course of discussion. This regards osmotic pressure as the diminution in that portion of the internal pressure in a liquid due to the heat movements of its molecules, caused by the loading of the solvent molecules by the solute. This loading or association explains at once the lowering of vapour pressure produced in solution, and it indicates clearly why there should be a difference of pressure on the two sides of a semi-permeable membrane, and why the pure solvent should flow through as it does into the solution.

Finally must be alluded to the conception apparently favoured by Sir Oliver Lodge. In the interior of every liquid is an intrinsic pressure due to the mutual attractions of its molecules—a pressure of enormous magnitude. It is the diminution in this pressure from the direction outwards near the surface of a liquid which is held to account for surface tension. This pressure will be increased, thinks Sir Oliver, when sugar is dissolved in water, and it is this increase in pressure which is the osmotic pressure.

It cannot be said that the meeting came to a final decision as between the rival theories, but it cannot fail to be of value for the advocates to have met and stated their views and criticisms fairly and directly in each other's presence. This is the value of such discussions, and we must anticipate as a result of the present one not only a clearing of our notions as to what solution means, and few subjects are of more fundamental importance to the physicist and chemist, but also a starting point for newer investigations and the discovery of fresh truths.

WAYLEAVES.

WE have received from Mr. C. VERNIER an advance copy of his further reply to the discussion in London on his paper read before the INSTITUTION OF ELECTRICAL ENGINEERS, which we reproduce below:—

I regret that Mr. Chamen's valuable communication, which gives the proposals of the Joint Committee of the Incorporated Association of Electric Power Companies and the Incorporated Municipal Electrical Association, only reached me after I had completed my reply in the May number of the *Journal*. The importance of these proposals merits special consideration in that they are the considered conclusions of a committee whose competence is indubitable. I think it is only right, however, that I should call attention to some of the limitations of these proposals, limitations which I am confident the Committee themselves would be the first to acknowledge, and which I think must be attributed, in the words of Mr. Chamen, to "such powers as it is reasonable to expect that Parliament will give," to which I would add, "under a private Bill." Briefly, these proposals may be summarised as follows:—

(1) The undertakers may apply to the Board of Trade for a certificate of the public utility of a main.

(2) On receipt of such an application, the Board of Trade will notify the landowners and invite them to forward their observations within one month.

(3) The Board of Trade may thereafter decide to issue or withhold a certificate of public utility, either with or without a local inquiry.

(4) The amount of the compensation and all other questions arising in respect of the lines, unless mutually agreed between the parties, shall be fixed by a single arbitrator appointed by the Board of Trade. This same arbitrator shall sit continuously.

The first three of these proposals are closely in agreement with the views I have given in the paper and in my reply to the discussion. The fourth is also on the lines of one of my proposals put forward for discussion. In this case, however, I made certain stipulations adopted from recent Acts, such as the Housing and Town Planning Act, 1909, designed to reduce the costs of arbitrations. Unless the cost of arbitrations is minimised, the powers contained in the Committee's clause can seldom or never be exercised to limit exorbitant rents, but will only be useful in the most obstinate cases of a complete refusal to allow the grant of a wayleave. An ordinary Board of Trade arbitration is by no means an inexpensive method of settling disputes, and taking into account the costs of the arbitration and legal expenses in connection therewith, the outlay will seldom be less than £50, and may easily run into three figures.*

To this must possibly be added the cost of a Board of Trade inquiry before a certificate of public utility is granted, which would have to be borne by the undertakers.

As I mentioned in my reply, on account of the numerous landowners commonly encountered on a route, the amount of wayleave rent involved in any particular case is often under £10, and seldom exceeds £20 per annum, which means that recourse to arbitration will usually absorb the utmost possible saving on rentals for many years. This would not, perhaps, be serious if awards in such arbitrations were accepted as a precedent in the fixing of rents by other landowners, which by no means follows, but it is really only in this way, and also through the moral effect of a Board of Trade certificate of the "public utility" of the proposed main, that undertakers could expect any relief from exorbitant rent charges under the proposed Bill.

I would here make the suggestion that if arbitration is the method adopted, all landowners, tenants, and occupiers on the route of a main declared by the Board of Trade to be of public utility, and desirous of having the question of compensation determined by arbitration, should be convened at one and the same hearing of the arbitration in order to reduce expenses. I assume, of course, that the arbitrator would have in his discretion the awarding of the expenses of the arbitration.* This is very important, as unless the arbitrator can exercise discretion in the award of costs, landowners who wished to secure exorbitant rents might refuse to quote reasonable terms, so as to compel the undertakers to go to arbitration, knowing full well that the terms they demand are not less good than the terms the undertaker would be likely to secure in an arbitration, plus the expenses and trouble of the arbitration.

Further, it is suggested that the same Board of Trade arbitrator sitting continuously shall hear and determine "all" questions arising in respect of the line or lines authorised by any certificate of the Board of Trade.

As the questions which an arbitrator will be called upon to decide will be chiefly compensation questions, the arbitrator should be an expert practical surveyor, preferably not in private practice. Engineering questions should be excluded from all matters of reference to the arbitrator, and should be decided on an appeal by the Board of Trade.

I received an impression during the discussion that the effect of an arbitration was not always clearly understood, as some speakers seemed to infer that because it is proposed that the Board of Trade should appoint the arbitrator, the settlement of the dispute is in their hands. This is not the case, as the Board of Trade merely appoint the arbitrator, but have no authority to vary his award. Moreover, where in an Act it is directed that a question is to be determined by arbitration, the matter is outside the jurisdiction of a court, which can only interfere to set aside the award in the event of misconduct by the arbitrator, or where an arbitration or an award has been improperly procured.†

The suggestion that all questions in respect of a line should be determined by a single arbitrator sitting continuously must, therefore, be considered from the point of view that as no provision has been made in the draft clause for an appeal to some judicial body, *e.g.*, the Railway Commissioners, the various awards of the arbitrator must be accepted in all cases as final and binding upon the parties.‡

It further presupposes that the awards given by the arbitrator will generally be in a sense favourable or acceptable to the undertakers, but if this should not turn out to be the case the promoters having deliberately secured by their Act—assuming this is granted—that matters in dispute must be determined by the same arbitrator sitting continuously, and having made no provision for an appeal, there is no appeal from his decisions unless these are *ultra vires* or improperly secured, and the undertakers cannot call for his removal except on the ground of misconduct. For my part, I do not consider this at all satisfactory, and I suggest that this matter requires further consideration and amendment by inserting a right of appeal to the Railway Commissioners.

The least satisfactory feature of these proposals is the absence of any provisions designed to limit the total time which must elapse between the date when the undertakers make an application and that when the work can actually be commenced.

This period will, even in the most favourable of cases, be made up as follows:—

(*a*) Time for the Board of Trade to consider the application and notify landowners.

(*b*) One month allowed to the landowners to reply and make their observations.

(*c*) Time taken up by the Board of Trade in considering these replies and deciding whether to issue a certificate or hold a public inquiry.

* In two cases of Board of Trade arbitrations within my experience, which were of the simplest character, not occupying the arbitrator's attention for more than one hour, the total costs amounted to close upon £50.

* Arbitration Act, 1889, Section 11. Board of Trade arbitrations are regulated by the directions in a special Act, *e.g.*, Section 28, Electric Lighting Act, 1882, and by the Board of Trade Arbitration, &c., Act, 1874. Further, the Arbitration Act, 1889, regulates all arbitrations in so far as the directions in that Act are not inconsistent with the provisions of any special Acts governing the arbitration on the matters in dispute (Arbitration Act, 1889, Section 24).

† Electric Lighting Act, 1882, Section 28.

‡ Arbitration Act, 1889 (First Schedule, par. *h*.).

(*d*) Time taken up by a local inquiry (if any).

(*e*) Time taken by the Board of Trade to consider their official's report of the local inquiry (if any) and to issue the certificate of public utility.

(*f*) Time taken up by the arbitrator in holding the arbitration proceedings and considering and making his award.

Of these periods only two have any limit placed upon them, viz., (*b*) and (*f*). The latter is restricted in any case by the provisions of the Arbitration Act, 1889, to three months.*

These two periods may therefore together extend to as much as four months.

This last period could be very satisfactorily reduced if powers were granted, as advocated in the paper, to enter upon and use the land before compensation is fixed, as provided in Section 85 of the Lands Clauses Consolidation Act, 1845, for with such powers the time taken up by the arbitration proceedings and the issue of the award could in urgent cases be practically eliminated.

This leaves the time which the Board of Trade would require to carry out the various stages of the procedure outlined in paragraphs (*a*), (*c*), (*d*), and (*e*).

Lest I be thought guilty of exaggeration, I have looked up the time taken by the Board of Trade in signifying their consent in some recent cases to the erection of E.H.T. overhead lines. This approval, as is well known, is of plans of the route, and a description and design of the line. The latter are in many cases replicas of designs previously approved. In four cases, previous to the war, the shortest time was 10 weeks, and the longest 13 weeks, and since the war, the shortest time was nine weeks, and the longest 13¼ weeks, except in two special cases of munitions lines, where the period did not exceed three weeks. In all cases, except the last two, approximately one month of the time is taken up in advertising the scheme in the public Press on behalf of the Board of Trade, at weekly intervals for two consecutive weeks, inviting observations from the public during a period not exceeding 21 days.

From my own experience, I estimate that this could not be laid down at much less than eight weeks for each stage, or, say, between four and six months in all, provided no local inquiry is held, to which must be added certainly one month for the landowner's reply, and possibly not less than three months for arbitration, if compulsory powers for entry are not provided.

The total time absorbed in an ordinary straightforward case in securing expropriation is, therefore, not likely to be less than eight months, and may easily run into a year and more.

From these considerations, I conclude that, as in the case of the limitation of exorbitant rents, the powers proposed to be conferred by this Bill can never be exercised except in the most obstinate cases of the refusal of a wayleave, where no alternative for a diversion, even at a greatly increased cost, presents itself.

Mr. Chamen thinks that in the large majority of cases, the bare facts of the existence of these powers would be sufficient to cause the property owners to make reasonable agreements. I agree that this possibility is not to be under-rated, but only after a certificate of public utility has been issued.

We must, further, not overlook the fact that with compulsory powers new factors are introduced into the situation. There are, for instance, property owners who can be led into an agreement, but will not negotiate under the shadow of compulsion, others who will refuse to discuss a wayleave for a main unless the applicant can produce a certificate of its public utility, and yet others who will refuse to discuss or name terms for compensation, but would elect to have the terms settled by arbitration. It is not sufficient, therefore, to rely upon the moral influence of these powers unless these are backed by effective legal machinery.

I do not believe that the electrical industry will ever secure those facilities under a private Bill to which it is justly entitled, and in a matter so vitally essential to the economic life of the nation it is the duty of the Government to initiate and carry through legislation which will remove present obstacles and difficulties.

The prospect opened up by the recent appointment of a Board of Trade Departmental Committee offers an opportunity for a much bolder policy which should be pressed unflinchingly. As, moreover, the electrical industry cannot reasonably expect to secure greater facilities from Parliament than it considers essential to its best and freest development, our claims to this Committee should not be vitiated by any thoughts of pre-war prejudices or fettered by any such considerations as hampering precedents. I am here referring not merely to the question of compulsory wayleaves, but also to the larger questions referred to this Committee, with which the subject of this discussion is so intimately bound up.

In the words of the Prime Minister, addressing a Labour deputation, a week or two ago:—

The war presented an opportunity for the reconstruction of the industrial and economic conditions of the country such as had never been presented in the life of probably the world. There was no time to lose, and he believed that the after-the-war settlement was the settlement that would direct the destinies of all classes for generations to come.

"I am not afraid of the audacity of your proposals. I believe the settlement after the war will succeed in proportion to its audacity. The readier we are to cut away from the past, the better are we likely to succeed. I hope that every class will not be hankering back to pre-war conditions. Think out new ways. Think out even new ways of dealing with old problems. Don't always be thinking of getting back to where you were before the war. Get a really new world."

I think it would be well if I recapitulated the several points which I would consider essential to a really useful practical scheme for compulsory wayleaves:—

(*a*) That a certificate of the public utility of a proposed main be granted or, alternatively, an order for the compulsory acquisition of easements be issued by the Board of Trade on the application of statutory undertakers in suitable cases.

(*b*) The total time allowed from the date of application to the issuing of a certificate or of an order not to exceed three months.

(*c*) Compulsory powers to be allowed for entry upon the land in urgent cases before the determination of the compensation.

(*d*) The method adopted for the fixing of compensation to be in the first instance of the cheapest and most readily accessible description, supplemented by a right of appeal to some judicial body. The determination of all technical questions to be in the hands of the Board of Trade.

(*e*) The terms of tenure to be in perpetuity (or for at least 50 years), subject to the landowner's right to the reasonable use and development of his land, and for this purpose to require the removal or diversion of a main on giving sufficient notice at the cost of the undertakers. A right of appeal to the Board of Trade to be allowed in case of dispute. The wayleave rents to be subject to revision at periodical intervals, as this is essential if the terms of tenure are to be in perpetuity, or for a long term of years.

(*f*) Wayleave rents to bear some relation to the rentals which are received by the owner for the ordinary use of his land.

(*g*) Compensation to be given, and apportioned equitably by the tribunal duly appointed to all beneficially interested in the land.

(*h*) All persons beneficially interested in the land on a given route, in the event of disagreement, to be convened at one and the same proceedings for the determination of the compensation if this is an arbitration or an appeal.

(*i*) Damages occasioned in the execution of the work to be settled separately from the amount of compensation for the wayleave.

(*j*) Compulsory powers to be granted for the cutting and trimming of trees.

(*k*) Special provisions to be made for the grant of a compulsory wayleave in the case of owners who either cannot be found or are absent from the country, as in the Lands Clauses Consolidation Act, 1845.

The second part of Mr. Chamen's communication deals with the abolition of the local authority's power of absolute veto on the question of the erection of overhead wires. The suggested clause, except in one respect, could not be improved upon, and should finally remove all doubts as to the power of a local authority to prevent and obstruct the development of overhead transmission and distribution lines mainly on private property.

There should, however, be some limit to the time allowed to the Board of Trade for a decision as to whether the consent of a local authority is being unreasonably withheld, which, I suggest, in such a simple matter, should not exceed two months, and preferably only one month. I have given an example in my reply to Mr. Welbourn where the time which elapsed in one such case was five months, and this is not greater than I would expect in ordinary cases if there is no limit placed upon it by law.

* First Schedule (par. C).

ECONOMIES IN LIGHTING IN RELATION TO FUEL SAVING.

AT the annual meeting of the ILLUMINATING ENGINEERING SOCIETY, when the new President, Mr. A. P. TROTTER, took the chair, a discussion upon the above subject took place.

MR. L. GASTER, who opened the discussion, said that the first point to consider was the extent of the economy in fuel that could, in any circumstances, be expected to result from restriction in lighting. The actual output of coal last year was 30 million tons less than that of the last year before the war. The actual amount of coal used for lighting purposes was difficult to arrive at, but, in giving evidence before the Committee on the Summer-Time Act, Mr. H. Faraday Proctor stated that the total units generated for both light and power was about 2,000 millions, of which 23 per cent. was estimated to be used for lighting. Assuming 4½ lb. of coal per unit sold, this would be equivalent to about one million tons of coal used for the lighting load. From figures put forward by the managing director of the Sheffield Gas Co., it might be assumed that the total consumption of coal for lighting by both gas and electricity supply authorities was well within

six million tons, or only 2½ per cent. of the total coal output of the country. When it was recalled that a very considerable portion of this was used for indispensable purposes, *e.g.*, in munition and other factories, it would be seen that we must not form too extravagant a conception of the possible economies in the lighting field. This impression was confirmed by a study of the saving estimated to be made during the operation of the Summer-Time Act for four and a half months in 1916. According to the report of the Committee, the combined saving on the part of the gas and electricity supply authorities was about 320,000 tons. It would clearly be folly to aim at an undue diminution in munition and other factories or in the streets. In the latter case, especially, any fuel saving accomplished would be of small value in proportion to the risk to safety and the public inconvenience so caused. At the same time, whilst the recent alteration in street lighting in the Metropolitan area had been a great improvement, there was probably still opportunity for inquiry in connection with the screening devices sometimes adopted. He therefore suggested as a preliminary to any restriction of lighting with a view to fuel economy the division of illumination into four main categories:—

(1) Safety, as regards prevention of accidents.
(2) Lighting for indispensable purposes, such as munition works, &c.
(3) Lighting for public convenience.
(4) Luxury and spectacular lighting.

The first two divisions of lighting clearly ought not to be interfered with except in cases where it could be clearly and indisputably shown that the light was excessive or wrongly applied for the purpose in view. Division (3) would only be touched in case of grave necessity, whilst division (4) would be the first to which further restrictions would be applied. Even before the war it was pointed out that the exhibition of large numbers of lamps, or very powerful lamps of undue brilliancy, outside shops and places of entertainment was a bad policy; by a little ingenuity it should surely be possible to attract the public attention without this species of glare. Similarly, in shop window and restaurant lighting there was frequently waste. In some cases this took the form of lamps shrouded in crinkled paper, a relic of the period of severe restrictions in lighting, when wasteful methods of obscuring lamps were in common use. The allocation of a certain amount of electricity or gas for specified purposes or for a given area might be considered, and methods of using the available light to the best advantage made more familiar to the general public. An educational movement would probably be better than hard-and-fast regulations. In conclusion, Mr. Gaster suggested that the whole question should be submitted to a joint committee, on which the Society should be represented, during the summer months, with a view to advising the authorities regarding the best steps to be taken when the winter months arrived.

Mr. H. FARADAY PROCTOR, in a communication, said it was a reasonable assumption that diminution in the consumption of electricity due to economies being advocated would not exceed about 10 per cent. Such a reduction would result in lowering the coal consumption of electrical undertakings by 1½ per cent. only, having regard to the fact that the lighting units sold by electrical undertakings were only about 23 per cent. of the total output. The reduction would amount to a saving of 60,000 tons of coal for the whole of the United Kingdom. The loss in revenue to the electrical undertakings would be about £500,000 per annum. As few, if any, electrical undertakers were making more than a reasonable profit on their capital outlay, a diminution in revenue unaccompanied by a corresponding diminution in costs must ultimately result in an increase in the charges, or, at least, in the postponement of a reduction of the same. In either case, the consumer was not likely in the long run to reap a financial benefit commensurate with the reduction of his consumption of energy. It was, therefore, of little use looking to a substantial reduction in coal consumption as resulting in economy in lighting. To conserve coal, the raw material must be used efficiently. The burning of coal as fuel prior to the abstraction of the by-products was in itself wasteful, but the great power stations were among the least sinful in their methods. Assuming, for the sake of argument, that the coal consumption of the average privately-owned engine per H.P.-hour was double that of the engine in an up-to-date power house, the change-over of only 16,000 KW. of load of 25 per cent. load factor from privately owned plant to public supply mains would result in a saving of about 60,000 tons of coal per annum. (The losses in belting and other inefficiencies superseded were set against the transmission losses.) Thus a comparatively small change-over by power users to up-to-date methods of driving would result in economies that would balance those obtainable from general lighting economies and would benefit all parties concerned. Economy in lighting must be looked upon purely as a war measure, and that solely with a view to a small reduction in the coal consumption throughout the country. He hoped the Government would in the near future bring pressure to bear upon the users of private plants, whether by taxation or otherwise, and compel them to use the public supply wherever such was available on reasonable terms. The end to be aimed at was that the burning of coal should be prohibited except to licensed users. The result would be enormous economies, and such a clear atmosphere in our country that, amongst other things, economy in artificial lighting would be an indirect result.

Mr. J. F. CROWLEY thought the suggestion to submit this matter to a joint committee was a very sound one. A point to be remembered in connection with the necessity for using coal more efficiently was that the output of coal in this country per worker in the coal industry had been steadily falling for the past 50 years, and to-day it stood lower than the output per man in any country of any size in the world. As regarded the use of coal for power purposes, none of the authorities now considering this problem suggested that there should be less power used in the future. Indeed, the demand was for the greater use of power, and therefore if we were to conserve our fuel supplies we could only do so by improving our methods of power production and the use of the power afterwards. As to lighting, he favoured restrictive measures, if necessary, quite apart from war measures, in connection with luxurious lighting such as display advertisements and things like that. As with power, the problem was one of the efficient production of light and its application.

Mr. J. S. DOW said the policy of the Illuminating Engineering Society had always been that much of the display lighting was excessive and quite unnecessary for the purpose in view, and it mostly came on at a time when the supply authorities found it no easy matter to deal with the factory load. That also applied to the short time during which this outside lighting was now indulged in under the new regulations, as regarded street and shop lighting.

Mr. A. P. TROTTER said he had paid some attention to this matter, but had not succeeded in making much of it. Economy was, of course, essential at the present time, although when it came to be reckoned out it would be found that the amount of coal actually saved was extraordinarily small so far as the economies in domestic houses were concerned. At the same time, there were the other economies that had been pointed out, and although he was not at all sure that it was not an undue interference with the liberty of the subject to say that he should not do these things, yet he confessed that tobacconists' shops were, before the war, and to some extent were again now, painfully dazzling in the amount of outside light that they employed. They would say that it was only advertisement, but he was rather doubtful as to the effect of treating this class of lighting from the point of view of economy. There was one serious and absurd waste going on in many parts of London, and that was the continuance of arc lamps in opal globes which were now painted black. These arc lamps were originally taking 9 amperes, and were probably still taking 7 amperes, as otherwise they would not regulate. A 60-volt incandescent lamp could be used on these posts without any alteration of the wiring and an obvious economy effected at once. Why it was not done he did not know.

Mr. GASTER, replying to the discussion, said that, whether the authorities accepted the advice or not, he felt it was the duty of the Society to offer advice as to where economies could be made.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

CHILE.—By a law, dated January 8th, the 50 per cent. increase in Consular fees imposed last year for the period April 1st to December 31st, 1916 (see the ELECTRICAL REVIEW for June 23rd, 1916) has been re-imposed.

ARGENTINA.—New laws have recently been promulgated amending in certain respects the Tariff Law in force. By Law No. 10,220, dated February 21st, a duty of 5 per cent. *ad val.* is to be levied until December 31st next on goods entitled to duty-free importation under the Law in force (with certain specified exceptions). [Among the articles affected by the new Law are plant and material for electric tramways.]

Law No. 10,221, dated February 21st, provides that until December 31st, 1917, a surtax of 2 per cent. *ad val.* shall be levied on goods which, under the Tariff Law, are subject to an *ad valorem* duty of from 10 to 20 per cent., and that this surtax shall be increased by 5 per cent. in the case of goods on which the existing duty payable exceeds 20 per cent. *ad val.* [Electrical goods are not directly affected by this Law.]

BRITISH DOMINIONS AND POSSESSIONS.—Complete lists of the articles which are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Newfoundland, Egypt, Malta, Cyprus, Mauritius, Ceylon, Straits Settlements, Hong-Kong, Nigeria, Gold Coast, Jamaica, Barbados, Trinidad and Tobago, and British Guiana, have been issued as Supplements to the *Board of Trade Journal* for April 19th and 26th. The information in these Supplements supersedes that given in the Supplements issued on January 18th and 25th respectively. Copies of the Supplements may be obtained, price 3d. each (post free 4d.) from H.M. Stationery Office, Imperial House, Kingsway, W.C. 2.

FRANCE AND ALGERIA.—A complete translation of the new French Ministerial Decree of April 13th, which restricts

the importation of goods into France and Algeria from foreign countries, has been published in the official *Board of Trade Journal* for April 26th. The new Decree contains:—

1. A list of goods which may be imported freely into France and Algeria, without previous authorisation, in virtue of the provisions of Article 2 of the Decree of March 22nd;

2. A list of goods which may be imported into France and Algeria only under special licence; and

3. A list of articles the importation of which is to form the subject of a special Decree.

The Decree provides that the prohibition of importation shall not apply to—

(*a*) Importations under the "temporary importation" *régime*, when the goods are subsequently to be re-exported;

(*b*) Transhipment operations in roadsteads and ports;

(*c*) Transit operations to neutral countries, governed by special agreements.

Included in the list mentioned in (1) are crude asbestos, crude mica, graphite, caoutchouc, balata, and gutta-percha. List (2) includes commercial advertisements, but nothing of special interest to the electrical industry, which is chiefly concerned with list (3) in which the following are included:—Iron and steel wire; copper, pure or alloyed with zinc, tin, aluminium or manganese; lead; tin; zinc; nickel; mercury; antimony; cadmium; bismuth; cobalt; dynamo-electric machines; electrical wire and cables; armatures for dynamo-electric machines, and detached parts; electric accumulators and detached parts; dry batteries; zinc manufactures; manufactures of nickel alloyed with copper or zinc.

Goods not included in the Lists are subject to the arrangement as to "contingents"—see the ELECTRICAL REVIEW for April 20th. These goods may for the present be imported without special permission until the quantities which will be allowed in have been fixed.

A Presidential Decree dated April 14th provides that the functions conferred on the "Comité des dérogations aux prohibitions d'entree" are to be delegated to the "Commission Interministérielle des Bois et Metaux" in so far as concerns goods in List 3.

A further Ministerial Decree, also dated April 14th, provides that merchants or manufacturers who desire to import goods specified in List 3, for delivery to a public authority (State, Department, or Commune), either in the condition in which they were imported or after having been worked or manufactured, must submit to the competent authority four copies of an application in the prescribed form, and must attach thereto documentary evidence, with an indication of the use to which the goods are to be put, and their weight or measurement.

When the goods to be imported are destined to be stored in a shop for sale or to be delivered to the public, either in the rough state or after having been worked or manufactured, the merchants or manufacturers must submit the application to the Ministry of Commerce, 66 rue de Bellechasse, Paris.

The authority concerned is to transmit four copies of the application, with its opinion thereon, to the secretariat of the "Commission des Bois et Metaux," 14, rue de la Trémoïlle, Paris.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

6,812. "Swivelling trolley pulleys of overhead electrically-propelled vehicles." A. WOOD. May 14th.

6,823. "Synchronised mechanism under electrical control." P. J. R. CRAMPTON. May 14th

6,835. "X-ray couch permitting of wet surgery and radioscopy." A. E. DEAN. May 14th.

6,870. "Couplings or connections for electric cables of railway vehicles, &c." J. STONE & CO. AND M. WALTON. May 14th.

6,871. "Brush and terminal contact mechanism of dynamo-electric machines." A. H. DARKER AND J. STONE & CO. May 14th.

6,889. "Method of installing and disposition of electrical equipment for motor vehicles." T. L. D'ORVILLE REEPMAKER. May 14th.

6,849. "Process of electric spot-welding." R. H. LE HOFFER & T. E. MURRAY. May 14th, (U.S.A., June 28th, 1916.)

6,926. "Signs, telegraphs, &c., electrical advertising devices." H. K. HARRIS. May 15th.

6,927. "Attachment for magnets." C. O. BASTIAN. May 15th.

6,932. "Electric motor control systems." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). May 15th.

6,936. "Loading coils for telephone circuits." G. E. BAIRSTO, BRITISH INSULATED & HELSBY CABLES; LTD., AND H. H. HARRISON. May 15th.

6,952. "Electrical connections for utilising voltage curve in metal-vapour rectifiers fed with polyphase current." Akt. Ges. Brown, Boverie et Cie. May 15th. (Germany, May 18th, 1916.)

6,993. "Means for sealing openings in roof and walls of electric furnace through which electrodes are introduced." H. ETCHELLS & H. A. GREAVES. May 16th.

7,001. "Electric resistance elements." BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. May 16th. (U.S.A., June 8th, 1916.)

7,004. "Electric lampholders." CABLE ACCESSORIES CO. & F. H. REEVES. May 16th.

7,009. "Electric switches." FYFE, WILSON & CO. AND F. C. STOCKEL. May 16th.

7,016. "Electromagnetic apparatus for controlling discharged torpedoes." A. WATKINS. May 16th.

7,034. "Magneto-ignition apparatus for internal-combustion engines." AKT. GES. BROWN, BOVERI ET CIE. May 16th. (Germany, May 16th, 1916.)

7,058. "Electric switchboards and manufacture thereof." W. N. RINGROSE. May 17th.

7,080. "Electrical measurement of sound." M. WALKER. May 17th.

7,092. "Electric fuses." E. G. NICHOLLS. May 17th.

7,093. "Automatic selectors for telephone systems." SIEMENS & HALSKE AKT. GES. May 17th. (Germany, May 4th, 1916.)

7,118. "Sparking plugs." A. HARMS & J. A. TURNER. May 17th.

7,122. "Radio-signalling systems." L. DE FOREST & C. V. LOGWOOD. May 17th. (U.S.A., May 23rd, 1916.)

7,137. "Telephone receivers." A. MARR. May 18th.

7,141. "Electric batteries of flashlights." H. BIEBER. May 18th.

7,150. "Wireless telegraph aerials." S. HALL. May 18th.

7,156. "Electric motor controllers." P. S. BROOK & J. A. HIRST. May 18th.

7,185. "Electric condensers." DUBILIER ELECTRICAL SYNDICATE. May 18th. (U.S.A., May 2nd, 1916.)

7,191. "Apparatus for control of dynamo-electric machines." W. BROOKE. May 18th.

7,200. "Microphones." S. G. BROWN. May 18th.

7,206. "Ionic relays, amplifiers or detectors." S. G. BROWN. May 18th.

7,254. "Telephone, &c., receivers." S. G. BROWN. May 19th.

7,262. "Ignition devices for internal-combustion engines." G. ROESCH AND C. TALBOT, LTD. May 19th.

7,269. "Sparking plugs for internal-combustion engines." IMPERIAL TRUST FOR THE ENCOURAGEMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH & J. D. MORGAN. May 19th.

7,270. "Electric contact-making devices." R. W. PAUL. May 19th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged and all subsequent proceedings will be taken.

914. AUTOMATIC FIRE ALARMS. J. Jones. January 20th, 1916. (105,575.)

6,828. PROCESS FOR PURIFYING LIQUIDS. Elektro-Osmose Akt. Ges. (Graf. Schwerin Ges.). June 10th, 1915. (100,638.)

6,408. METHOD OF AND APPARATUS FOR STERILISING WATER AND OTHER POTABLE LIQUIDS. W. J. Mellersh-Jackson (C. F. Burgess Laboratories). May 4th, 1916. (105,641.)

9,243. LIGHTHOUSE AND BEACON LIGHTS. W. F. A. Richey, W. A. Jeboult and H. J. S. Stobart. June 30th, 1916. (105,678.)

12,609. WIRELESS CONTROL SYSTEMS. M. Tocchio. September 6th, 1916. (105,702.)

6,104. METHOD OF AUTOMATICALLY TAKING UP SHRINKAGE OF COILS OF ELECTRIC TRANSFORMERS AND OTHER ELECTRIC APPARATUS. J. Hall & J. R. Kirk. April 28th, 1916. (105,800.)

6,745. ELECTRICAL RADIATORS. J. S. A. Primrose. May 11th, 1916. (Cognate application, 6,746/16.) (105,809.)

7,694. ELECTRICAL SWITCHES. H. W. Cox & J. H. Thorne. May 31st, 1916. (105,820.)

8,509. SECONDARY ELECTRIC BATTERIES OR ACCUMULATORS. H. Deane and Chloride Electrical Storage Co. June 16th, 1916. (105,828.)

9,921. INTERCOMMUNICATION TELEPHONE SYSTEMS. J. W. Dungey. July 14th, 1916. (105,838.)

11,114. BATTERY CELLS OR TANKS. W. C. Fairweather (Lake Torpedo Boat Co., U.S.A.). August 7th, 1916. (105,849.)

16,453. PROTECTIVE DEVICES FOR ELECTRIC CIRCUITS. W. J. Mellersh-Jackson (Baruch Electric Controller Corporation, U.S.A.). November 16th, 1916. (105,871.)

Electrolysis in Open Suppurating Wounds.—Charles Russ states that electrolysis can be applied to all suppurating areas provided these are such as to permit the superposition of a column of fluid through which the current can flow. Many septic war wounds could be healed in this way without pain and without the irritation of antiseptic solutions. Given an open suppurating surface, an irregular wound, or a sinus discharging pus, the first step is to submerge the lesion in sodium chloride solution, 1 or 2 per cent. This is done in the case of ulcers of the leg, for example, by placing over the ulcer a glass cylinder, which is made fluid-tight to the healthy skin by plasticene. A carbon or platinum foil electrode is just submerged in the sodium chloride contained in this cylinder, and under the limb is placed a large saline-soaked pad. The pad is made the negative electrode and the disk over the ulcer the positive, and a constant current of a few milliamperes is passed. Thereupon the chlorine atoms become linked to the bacteria in the granulations, and in moving to the positive electrode they carry the organisms out of the ulcer. There is also a strong germicidal effect proceeding within the contents of the glass cylinder, and, further, an increased blood flow is induced in the part. The aim of the electrolysis is to provide a liquid highway (NaCl) for the bacterial emigration from the wound. The author adds that, while the chlorine atoms are carrying the organisms and pus cells out of the blood, sodium atoms, of course, are entering the tissues, and care must be taken that the amount of sodium is not excessive, or the alkalinity set up will be painful, and there may be a retardation of healing due to the toxic effect of sodium upon the cell protoplasm. The ideal to be aimed at is to keep the reaction at the body surface neutral or only slightly alkaline. Certain organic acids of rather low conductivity if mixed with sodium chloride are comparatively little decomposed, and if only a small current flows, the acid (as such) is free to neutralise the alkalinity of the sodium atoms as they arrive at the cathode. The author concludes that the clinical results so far obtained justify a much more extended use of electrolysis.—*British Medical Journal.*